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IN CONNECTION WITH THE IMPURE CROTON WATER SUPPLY, the Aqueduct Commission has ordered its chief engineer to examine into the matter, and if it is not within the power of the commission to take action, the chief engineer is to report what, in his opinion, can be done by the Legislature or otherwise to correct the evil.

THE NEW YORK & NEW JERSEY BRIDGE CO. elected new officers on Sept. 1. A committee was appointed to perfect plans for consolidating the two companies, and it is said that this consolidation under one president and board of officers will probably take place in October. It is also said that work on the piers will then commence. The President of the New York Co. is Mr. JOHN B. KERR; Mr. GEORGE W. GREENE is vice president; Mr. THOMAS C. CLARKE, Chief Engineer, and Mr. CHARLES H. SWAN is Secretary.

THE NIAGARA FALLS TUNNEL has now 1,175 ft. of its 3,530 ft. excavated.

THE LONGEST TELEGRAPHIC CIRCUIT ever established is said to have been that whereon a direct message was sent from the city of Mexico to the telegraphic congress at Washington, D. C. The message came by way of El Paso, Kansas City, Chicago, Buffalo and New York to Washington.

THE MERSEY RIVER TUNNEL DISPUTE between the Liverpool Corporation and the contractor, as to damages for a rescinded contract, has been settled. As stated in our issue of Aug. 15, the Lord Chief Justice made Sir JOHN COODE, late President of the Institution of Civil Engineers, the arbitrator in the dispute. Sir JOHN has just awarded to the contractors the sum of $72,115, which was about half what they claimed.

THE SIMPLON TUNNEL, according to the latest plans, would cost $16,000,000. It would pierce the Pontine Alps, in the Canton of Valais, at a height of 11,124 ft. above the sea. Its length would be 117,000 ft., or 22.1 miles. The tunnel alone is estimated at $13,450,000, but the approaches and interest on capital will bring the amount needed up to that first stated.

THE GEOGRAPHICAL AND COMMERCIAL ANTARCTIC EXPEDITION, proposed by Baron Nordenskjöld and his friends will require a capital of $75,000. Of this amount $50,000 has been subscribed.

A 40-CALIBRE 6-IN. GUN, the first of this length, is being completed at the Washington ordnance foundry. The gun is 20 ft. 3¾ ins. long, and exceeds the longest previous naval gun by five calibres. The 100-lb. projectile used is to have a muzzle velocity of 2,150 ft. per second. This gun is one of a pair intended for cruiser No. 12, *The Pirate*.

THE NICARAGUA CANAL, says a Greytown dispatch of Aug. 15, is progressing satisfactorily, though the force has been reduced. The breakwater is now extended 1,030 ft., and dredging in the channel has been recommenced. The excavation in the canal proper is going on, though the soil, which was before almost all sand, is now showing some clay.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a derailment near a bridge over Third creek, near Statesville, N. C., on the Richmond & Danville R. R., Aug. 27. According to the published statement of the general manager the wreck was caused by the removal of a rail near the east end of the bridge. The engine and all the cars went down the bank into the creek. There were 17 passengers and 5 employees killed, and 26 persons injured. Several of those killed were drowned, being caught under the wreckage. The train consisted of a baggage and mail car, 2 passenger cars, a sleeping car and the superintendent's private car. Some accounts state that rotten ties allowed the rails to spread. The jury's verdict mentioned both the removed rail and defective track. Another serious derailment occurred Aug. 31 near Tell City, Ind., on the Tell City branch of the Louisville, Evansville & St. Louis R. R. A broken tire on a truck or driving wheel of the engine is said to have caused the accident. The train, which was a mixed train, went over a high bank, and the wreck caught fire. There were 4 persons killed and about 10 injured. An engine and 10 coal cars ran into on open draw at Hamilton, Ont., on the Grand Trunk Ry., Aug. 30. Two men were killed. The engine driver is said to have mistaken a light at one of the summer cottages for the signal for the draw.

ANOTHER RAILWAY ACCIDENT is reported from Switzerland. An express train ran into another train near the railway station at Zurich. The latter train was being switched on to another track to make way for the express. Several persons were injured.

BRIDGE ACCIDENTS are reported as follows: the Cumberland St. bridge over the Baltimore & Ohio R. R. at Cumberland, Md., gave way while under repair Aug. 28; one man was killed and another severely injured. The bridge was of wood, 150 ft. long, and was built in 1872. It had been condemned and closed to traffic. Several small bridges in eastern New York have been washed out by floods.

SERIOUS FLOODS occurred last week in the eastern part of New York State, and much damage to property was caused around Troy, N. Y. Bridges were washed away or damaged and railway tracks washed out.

PAPER TRUCK WHEELS for locomotives have recently been referred to in the daily papers, with a statement that the Allen paper wheels would be adopted for pony trucks by the Pennsylvania R. R. Mr. T. N. ELY, General Superintendent of Motive Power of that road, states, however, that it is not contemplated to use such wheels on pony trucks, and that the wheels used on the engine referred to in the Pittsburg paper were evidently used in an emergency. The reporter evidently built up a story upon a very slim foundation.

THE HEATING OF RAILWAY CARS IN FRANCE is urged in a circular, of July 24, 1891, issued by YVES GUYOT, the French Minister of Public Works. He addresses this circular to the managers of the railway companies, and says, in effect, that in a circular of Dec. 16, 1890, he invited all companies to thereafter heat the cars of all classes. He says this measure has been adopted on some systems, but other companies have declared that the lack of material and special plant has prevented them from generally heating their trains, but they expected to do so in the coming winter. The Minister now wants to know what system of heating each line has definitely adopted; and at the same time he wants assurance that the circular of 1890 will be obeyed in full before the winter of 1891-92.

ALUMINUM AND ITS TONE QUALITIES was the subject of a paper read at the Scientific Congress at Washington by Prof. SPRINGER. He discovered in this new metal a latent quality that adapts it in a remarkable degree for use in the sounding-boards of stringed musical instruments. He says it differs from all other metals in the absence of comparatively continuous and uniform higher partial notes, which give the tone called "metallic." It also possesses an elasticity capable of sympathetic vibration uniform through a wide range of tone pitch, and in this quality it is superior to wood.

LOCOMOTIVE WHISTLES AS WEATHER INDICATORS have been suggested by the U. S. Weather Bureau. It is said that Prof. HARRINGTON has arranged a system of whistle communication by which people along the lines of railways can receive the forecasts.

TO MAKE PORTLAND CEMENT PROOF AGAINST FREEZING, Mr. REINHOFER, an Austrian engineer, recommends crystallized soda dissolved in water. In an experiment quoted he used 1 litre of Portland cement to 1 litre of lime and 3 of river sand. He mixed this with 1 kilo. of soda dissolved in 3 litres of water. The mortar thus made was exposed for 14½ hours to cold of a maximum intensity of 31.5°C. and was then put into a furnace for 3 hours. At the end of that time the "set" of the cement was found to be perfect, a fact which he attributes to the use of the soda.

A NEW DEPARTURE IN CONSULTING ENGINEERING has been made by H. Ward Leonard & Co., electrical engineers of this city. For $25 a year they agree to answer all questions from the superintendent of an isolated plant regarding new apparatus, the best methods of making improvements, and similar matters, while for $50 a year the company agrees to answer all questions from the manager of a central station plant regarding the management, electrical, mechanical and financial, of his station. This plan of conducting a consulting business is the outcome of Mr. LEONARD'S experience as head of the intelligence department of the Edison General Electric Co., and will probably be welcomed by many managers.

A BUSINESS BUILDING 550 FT. HIGH is proposed for lower Broadway, New York, and is illustrated in the New York *Sun*, of Aug. 23. The site would be next to the Washington Building, and the area to be covered would be about 162 ft. on Broadway by 200 ft. deep to Greenwich St. The architect is Mr. F. P. DINKELBERG, and the estimated cost is $4,000,000. There would be 20 stories in the office building and six more in the tower, which latter would rise 260 ft. above the roof of the building proper, and 550 ft. above Broadway. There would be 1,000 offices, with an average floor space of 300 sq. ft. for each office. The tower itself would contain offices. In general design it would follow the new type of architecture, in carrying the weight on a thoroughly tied and braced skeleton of iron and steel beams and posts, leaving the minimum weight upon the walls. It is a project, only, as yet, but the claim is made that all details are worked out.

BIDS FOR TORPEDO BOAT NO. 12 were opened at Washington on Aug. 26. The boat is to be made of steel, with twin screws, seagoing and of not less than 120 tons displacement. She must develop an average of 24 knots per hour for two consecutive hours, with a premium of $2,500 per quarter-knot up to 25 knots, and $3,500 per quarter-knot for all above 25 knots per hour. Deductions of $2,500 are to be made per knot for all below 24, and the Naval Department may reject the boat entirely if her speed falls below 22 knots. The vessel is to be completed in 12 months. The bids, exclusive of torpedoes and armament, were as follows; The Cowles Engineering Co., of Brooklyn, N. Y., $117,490, and the Iowa Iron Works, Dubuque, Ia., $113,500.

The Short Gearless Motor.

The part of an electric street railway motor which is by all odds most liable to break in service is the transmission machinery. The older motors of all types were furnished with metal gears. These broke so often that wood or rawhide teeth were substituted and a better service thus obtained. Nevertheless the use of a complicated train of gears has long been recognized as out of place, and several attempts have been made to overcome the defects of this construction. A successful type of gearless motor is now manufactured by the Short Electric Ry. Co., of Cleveland, O.

It is possible to design an electric motor of given power (say 15 HP.) upon two general plans. In the first, we have an armature revolving at high speed in a weak magnetic field. In the second, we have an armature revolving at low speed in a more powerful magnetic field.

The double reduction motor, long the standard in street railway practice, is a machine of the first type—one in which the armature revolves at high speed in a weak magnetic field. Its characteristics are the following:

It has 2 poles separated by a wide cylindrical magnetic gap in which a long drum armature revolves.

There is the least possible amount of iron and copper in the machine for its output in power, the armature speed being a maximum with safe regard to the effect of centrifugal force. In order to bring this high armature speed to a point where it can be utilized on the car axles, 2 reductions are necessary, so that for a complete 30 HP. car equipment we find 8 gears and pinions, 12 double bearings requiring special self-oiling arrangements, together with a large number of bolts, nuts and other undesirable parts.

The high speed of armature pinion and intermediate gear, and the constant wear on the other gears, make frequent replacements necessary, and at consequent large expense.

The single reduction motor is an advance on the double reduction motor, and is a step in the right direction—but it is only a step. In this form of machine as it is now built by the various companies, we have either a ring or a drum armature revolving between massive pole pieces at a speed of about one-half that of the double reduction armature. The weight of the machine is considerably increased because of the fact that the magnetic gap between the two pole pieces is increased rather than diminished, making it necessary to increase their strength by adding to the weight of iron and copper in the fields and armature. There are still 2 (in one type recently brought out, 4) heavy gears in each motor equipment, together with 8 bearings, bolts, nuts, etc. The amount of space taken up by the motor beneath the car is somewhat reduced, but there is still a very material complication.

In the gearless motor designed by the Short Co. it is believed that the final form has been reached. Referring to the machine in a general way, it will be seen from the cuts that all the gearing is absolutely eliminated, the number of bearings is reduced to 2 no each motor, and 4 in the equipment. The armature speed comes down to the minimum, namely, that of the car axles in practical operation. The noise of the gearing and "squealing" of the brushes on the commutator are entirely obviated, and there are but 3 wearing parts on each motor.

The intensity of the magnetic field is now at its maximum; this effect being due, not to a material increase in the weight of armature and pole pieces, but to the wholly different method of construction. Instead of 2 magnets, we find 8; instead of a wide magnetic gap, we find one extremely narrow, with consequent enormous intensity of the field of force. Instead of a drum armature of small diameter, we find a ring armature of comparatively large diameter and increased leverage; the sum total being that we have here in full measure a motor of the second type, namely, one with an armature revolving at low speed in an intense magnetic field, exerting a power fully equal to the motor with gearing and at a considerable less expenditure of current (i. e., *coal*), since all friction of gearing is eliminated.

The motor is complete in itself. It is not keyed to the car axle, *nor does it touch it at any point*. The motor as a whole can be taken off the car axle after removing a wheel. The weight of the two motors forming a 30-HP. equipment, is distributed over the entire truck, but it follows from what is said above that no part of the motor is borne directly upon car axles. Both motors are flexibly suspended at both ends, so that pounding on the rails, jolting and jarring of truck, crystallization of motor frames, wheels and axle of truck are entirely avoided. The armature is always and necessarily central.

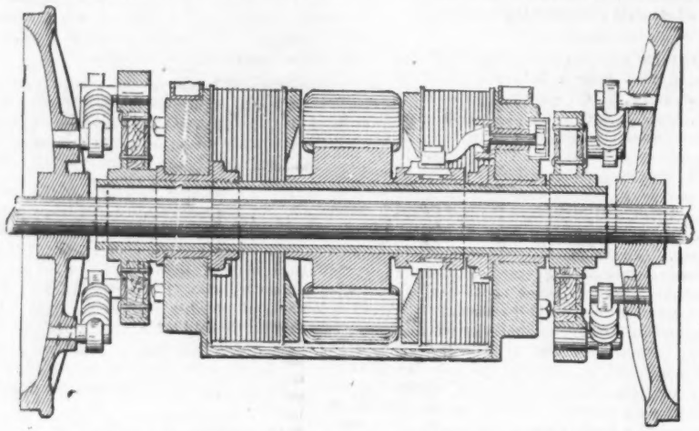


FIG. 1. VERTICAL SECTION, 20 HP. SHORT GEARLESS MOTOR.

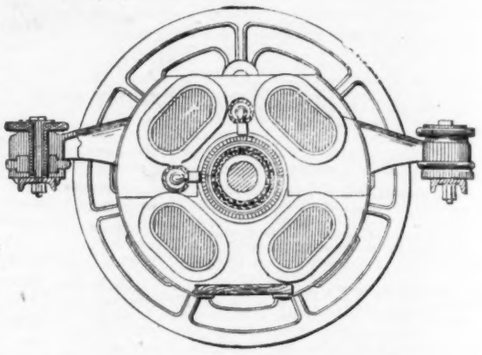


FIG. 3. SHORT GEARLESS MOTOR.

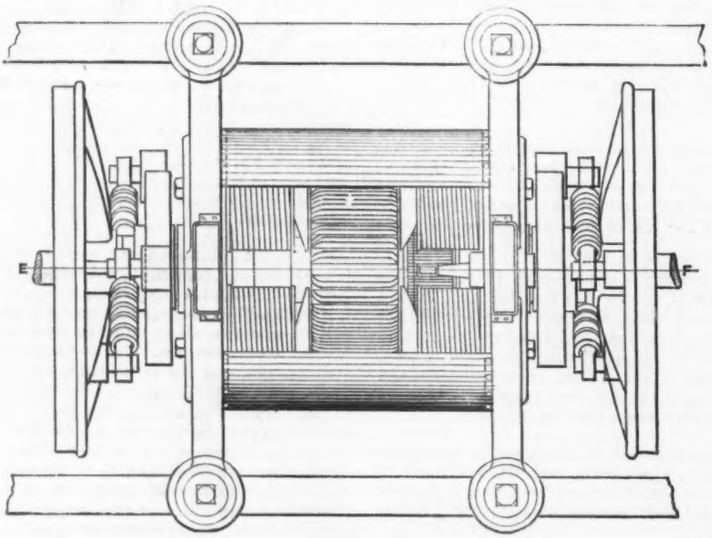


FIG. 2. PLAN OF SHORT GEARLESS MOTOR.

The field magnets are 8 in number—4 on each side of the armature. They face each other at a distance of only 10 in., and thus form a most intense magnetic field. The magnets are bolted to the framework of the motor, in the center of which are the bearings which carry the hollow armature shaft, presently to be described. The double arms running out from the framework to the cross girders on the truck make provision for the support of the entire motor. The insulation between these brackets and the girders is provided by means of heavy rubber bushings, through which pass the bolts. By removing the bolts attaching the fields to the supporting framework the coils may be quickly taken out, either for repair or to more easily get at the armature.

The armature is keyed to a hollow steel shaft, which is concentric with the axle of the truck, an inside clearance of 1 in. all around being provided for. The armature proper consists of a laminated iron core, upon which are mounted separate and entirely independent coils, following the well-known methods of the Short double reduction type of motor.

Mounted upon the hollow shaft, close to the armature is the commutator, which is protected from injury by the surrounding pole pieces. The commutator is massive in construction and of large diameter, the idea being that, because of its massiveness and slow speed, the wear will be reduced to a minimum, and the replacing of the commutator will occur only at long intervals. On the ends of the hollow shaft in the old type of motor were rigidly mounted 2 disks, the peripheries of which were insulated from the hubs by the special wooden web construction which is a distinctive feature of the gearing in the Short double reduction motor. Between the commutator and the disk on the one side and the armature and the second disk on the other, were the bearings, which are carried by the motor frame.

It has been before said that the motor has no connection whatever with the car axles; it follows, therefore, that it is necessary to provide means of propelling the car by making some attachment between the hollow armature shaft and the wheels. This was formerly done very simply by means of heavy coiled springs, which extended from the peripheries of the armature shaft disks to bosses on the

FIG. 4. SHORT GEARLESS MOTOR, OF LATEST DESIGN, SHOWING SPIDER.

wheels, as shown in Figs. 1 and 2. These springs were of great strength, and could pull a very heavy weight with but slight extension or compression. As they were attached to both disk and wheel upon circles of the same radius, their effort was a nearly direct circumferential pull.

The company has recently changed its method of connecting the driving sleave with the wheels, the system illustrated in Figs. 1-3 not meeting with the approval of street railway officials. In the new plan, a three-armed spider is keyed to the end of the armature sleave, as shown in Fig. 4 taken from the *Street Railway Journal*. At the end of each arm is a rubber cushion which presses against lugs on the wheels and thus rotates them. The spider is intended to revolve the wheel it presses against in one direction only. To provide for backward as well as forward motion, the spiders are arranged on the four wheels of the truck in such a manner that the forward left and rear right wheel are driven ahead by the motor and the other wheels are driven when the car is moved in the opposite direction.

From the center of the axle to the bottom of the casing is 12¾ ins. On a 36-in. wheel, which we strongly advise, not only in the gearless, but in other types of motor, there is thus a clearance of 5¼ ins., which is ample for all purposes.

At a speed of 10 miles an hour the armature revolves at 94 revolutions per minute with a 36-in-wheel. The equivalent speed of the single reduction motor would be at least 400, and of a double reduction motor about 1,200. The enormous advantage of the gearless form over all others is thus clearly evident.

A Pennsylvania Lumber Dam.

WITH INSET.

In the mountainous districts of Pennsylvania, which are traversed by streams of variable discharge, the flow being great and rapid after heavy rains, and very small during the dry seasons, parties engaged in clearing the forests for the purpose of procuring lumber for sawing in districts far removed from railways and canals, utilize the streams for transportation of the logs which are cut from the hillsides to points convenient for loading the manufactured lumber. Some of the work constructed for the purpose of utilizing the streams display considerable engineering skill. At different points along the stream, above and in the vicinity of the tracts which are being cleared, dams are constructed of timber and plank to impound the water ordinarily flowing in the stream, and when the dams are full the water is let out suddenly into the stream, causing an artificial freshet which floats the logs which have been cut on the mountain sides and hauled down by the nearest way to the bed of the stream. At a convenient point near a railway or canal a dam of more permanent character is erected, with a boom to arrest the progress of the logs brought down by the freshets, and with sluice-ways to convey the water for power to a saw-mill in which the logs are converted into lumber, so that freight is paid on only so much of the material as has a market value. The existence of such an arrangement as this in the mountains lying to the south of Johnstown, and on the streams tributary to the Conemaugh River, has caused considerable anxiety to the citizens of Johnstown. As has been already stated in ENGINEERING NEWS, Mr. J. J. R. CROES was employed by the Board of Trade of Johnstown to examine the condition of all the streams tributary to the Conemaugh with a view of discovering whether any dangerous structures existed on the streams. His report, which was presented on June 15, and to which allusion has already been made in our columns, contained what is, so far as we are aware, the only illustrated description of a work of the character above mentioned, and with the author's permission we present in this issue an extract from his report together with illustrations accompanying it from photographs taken by the author.

In the Stony Creek water-shed is the dam of the Johnstown Lumber Co. near the mouth of Shade Creek, 12 miles from Johnstown.

The bed of Stony Creek at the mouth of Shade Creek is about 1,464 ft. above the sea level, or 300 ft. above the level of Johnstown. The dam of the lumber company is on Shade Creek, about 4,750 ft. from its mouth, the bed of the stream at that point being 50 ft. higher than Stony Creek.

The dam is 18 ft. high in the center and 332 ft. long. It is built of timber cribs, and backed with stone and earth and sheathed with plank. For 165 ft from the south end the cribs composing the dam are not filled with stone. There are then stone-filled cribs, with a gate opening 8.5 ft. wide with timber gate worked by hand. Next is a sluiceway 29.4 ft. wide, closed by stop planks placed horizontally against timber posts. When it is desired to let out the water from the dam, these posts are cut away. The sill of this opening is about 10 ft. below the top of the dam.

There is next a spillway, planked over, 82 ft. long, with an apron of rough logs on which the overflow water falls. On the north bank stands the lumber company's sawmill. The location and dimensions of these structures are shown on "Plate 8," made from my surveys, and a very good idea of their construction can be obtained from "Plates 9, 10 and 11," which are from photographs taken on May 10, 1891, the points from which the views were taken being indicated on "Plate 8" by arrowheads. The area flooded by this dam is 434,000 sq. ft., and the quantity of water impounded is about 2,200,000 cu. ft.

The water-shed of the stream at this point is about 86 sq. miles. This pond is used by the Johnstown Lumber Co. for the storing of logs brought down from the heavily timbered district on the upper waters of Shade Creek, which is now being cleared.

For checking the logs as they are brought down the stream by splashes, a boom of cribs has been built, extending up stream from the dam about 650 ft. diagonally across the pond to a solid crib built out 120 ft. from the south shore. The position of this boom is shown on "Plate 8," and its location and construction can be understood from inspection of "Plates 12, 13 and 14."

When the stream is in flood, and whenever the water is sufficiently high to admit of splashing, the pool above the crib is filled with logs. At the time of my visit to the dam, when the water was low, the greater portion of logs in the pool had been removed, but in the bed of the stream above the pond, great numbers of logs were lying which had been brought down by splashing, and which would be displaced and brought to the crib by the next splash or freshet. The mass of timber thus ready to be brought down against the boom is very well shown by "Plate 15."

On Clear Shade Creek, about 16 miles above this dam, is the splash dam of the lumber company. This dam is 346 ft. long, and 13 ft. high in the channel of the stream, and is built of timber cribs without filling above the surface of the ground, for 211 ft. of its length. For 67 ft. at one end of the dam, there are no cribs, but simply sheet piling, driven into the ground. In the center of the dam is an opening, in which are placed two timber gates, each 7 ft. wide by 11 ft. high. There is no spillway provided below the top of the dam, the only outlet for the impounded water being through these two gateways. The dam backs up the water about a mile in the stream, and impounds about 6,000,000 cu. ft. of water.

The object of this dam is to furnish at a medium or low stage of water a means of flushing the river sufficiently to drive down to the boom dam the timber which has been cut from the adjoining hillsides, and hauled and deposited in the bed of the stream.

In the month of April last there was sufficient water flowing in the stream to enable one and sometimes two splashes to be made every day. At a time when the streams were at about one-third flood, the water at Johnstown standing 5 ft. on the gage on Franklin St., and the snow melting on the mountains, the gates at this dam were opened at eight o'clock in the morning, and the pond emptied in about four hours. The gates were closed again about three o'clock in the afternoon, and the pond filled sufficiently for another splash by eight o'clock the next morning. It took about six hours for the flood of the splash to reach the boom dam.

The splash dam on Clear Shade Creek cannot be considered perfectly secure in its present condition. The danger to be apprehended from it is that it might be suddenly washed away in a freshet, and the volume of water contained in it coming down to the boom dam, bringing with it the logs on the stream, would drive the mass of logs above the boom dam over that dam, with the probable result of breaking it away, driving the whole mass down into Stony Creek, and consequently through Johnstown, as in any freshet sufficient to cause such a disaster there would be flowing in Stony Creek 20,000 to 30,000 cu. ft. of water per second in a channel falling about 25 ft. to the mile. There are several points within the city limits at which a jam of logs would unquestionably occur under such circumstances with results disastrous to the whole plain.

In view of the possibility of such an event occurring, it is desirable that provision should be made in the splash dam for the overflow of the water of freshets through a spillway, which can be readily constructed in that part of the dam which is now made of sheet piling only. The rest of the dam should be raised 3 ft. and the cribs filled with stone.

German Steel Rails, Splice Bars and Steel Ties.

The following particulars of recent railway contracts in Germany are taken from notes in *Industries*, London. The management of the Left-Bank-of-the-Rhine Railway has received bids for the supply of 2,550 tons of steel rails, 2,700 tons of ties, and 1,870 sheets. The management of the Berlin Railway has invited proposals for 50,000 tons of steel rails, fish-plates, and tie-plates, which are to be delivered within two years. The management of this railway, at its last award of contracts, invited proposals for Vignoles or flange rails weighing 82½ lbs. per yd. The rails were to be 138 mm. (5½ ins.) high, 110 mm. (4.4 ins.) in breadth at the foot of the rail, 71 mm. (2.84 ins.) at the crown of the rail, and 14 mm. (0.56 in.) thick in the web. The Prussian State Railways follow the example of many foreign railways, and are at the present time making trial of heavier rails. The ordinary sections of rails now in use weigh about 67½ lbs. per yd. The Vignoles rails are to be laid on wooden ties. The quantity of rails and ties for which tenders have been invited by the Royal State Railway management has been considerably increased. Altogether contracts for supplying 140,000 tons of rails are shortly to be placed. The German steel works on the wholes eem inclined to make lower quotations, as the bargains recently concluded at Elberfeld would tend to show. Especially low quotations were made for steel rails. The Aix Mining Co. offered to supply 6,500 tons at $27.14; the Burbach Mining Works, 4,600 tons at $27.26, and Stumm Bros., 3,100 tons at $27.26. For ties made of ingot iron the tenders were as follows: The Aix Mining Union, 3,500 tons at $27.02; the Phoenix Co., 3,570 tons at $27.02; the Gutehoffnung Works, 3,500 tons at $27.02; Stumm Bros., 6,450 tons at $27.14; Messrs. Wendel, 4,500 tons at $27.02; Röchling Bros., of

Völklingen, 2,150 tons at $27.02. The Hösch Iron & Steel Works offered 1,200 tons of fish-plates at $27.48 delivered at the works. Of the tenders made by foreign firms Cammell & Co., Sheffield, England, offered 12,400 tons at $28.44, delivered free in the Ruhr district. The prospect of the forthcoming award of contracts has called forth some activity in the pig iron market, and 130,000 tons of Thomas pig iron were sold by the Thomas pig iron syndicate at an average price of $11.52 per ton.

Method of Simultaneous Culmination of Polaris With Alioth and Adjacent Stars in the Handle of the Big Dipper.

BY W. L. MARCY.

This method being independent of latitude and time has an attractive simplicity. Were Alioth in line as it was a century and a half ago (about 1750) it would be convenient and quite accurate, but it can now be used only by applying a correction from 11 to 20', dependent upon the latitude, or waiting about 28 minutes after it comes to the same vertical circle with Polaris, for Polaris to be due north. The interval is now 28 minutes when Alioth is below Pole, 29 minutes when above with an annual increase of 21 seconds. Alioth has come down as an inheritance with accumulating error. TRAUTWINE has made the correction in his late editions, but the U. S. Department of the Interior still retains the old diagram without any change in its manual of instructions to the U. S. Surveyor-Generals. Fifty years ago the error must have been 6' to 7' at latitude 45°, a very large error to be constant and in one direction. Owing to the precession, the next star in the handle of the Big Dipper, Mizar, is now opposite Polaris, the difference in R. A. being about 12 hours, becoming precisely 12 hours in 1893. The star has been nearer to the meridian when on a vertical circle with Polaris for many years and is the most available for many years to come, from 25 to 30. In about 50 years Alcaid, the star in the extreme handle of the Big Dipper, will culminate, with Polaris. It now comes on to the vertical circle 23 to 24m. after the culmination of Polaris, requiring a correction of 9' to 16'.

TABLE I.

Culmination of values of a and r for 1891 between α Ursa Minoris and ε, η and ξ Ursa Majoris.

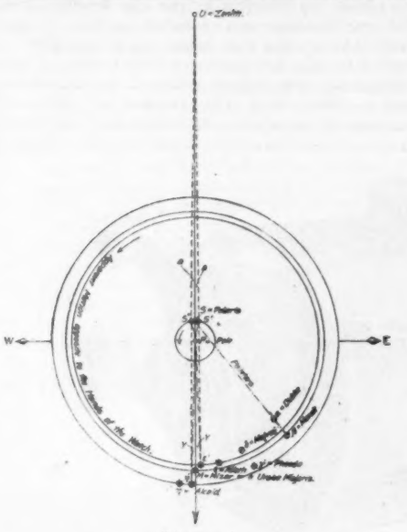
Latitude.	ALIOTH, (ε Ursa Majoris). Azimuth of Polaris when on the same vertical circle with Alioth.*	Alioth below Pole, Polaris above.	Azimuth above Pole, Polaris below.	ALCAID, (η Ursa Majoris). Azimuth of Polaris when on the same vertical circle with Alcaid.†	Alcaid below Pole, Polaris above.	Alcaid above Pole, Polaris below.	MIZAR, (ζ Ursa Majoris). Azimuth of Polaris when on the same vertical line with Mizar.‡	Mizar below Pole, Polaris above.	Mizar above Pole, Polaris below.
	a	r	r	a	r	r	a	r	r
° ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
30	11 03	22.24	49.65	9 08	26.29	75.91	00 14	22.87	51.12
35	11 41	21.00	57.41	9 39	24.29	95.10	.....	21.56	58.87
40	12 29	19.76	68.85	10 19	22.81	133.7	.....	20.26	75.45
45	13 32	18.50	90.37	11 11	21.13	248.6	00 17	18.93	102.12
49 51 26	.....	.....	.....	.....	.....	Infinite.	.....	.....	.....
50	14 53	17.19	144.40	12 18	19.43	7664.0	.....	17.56	176.3
52 30	15 43	16.51	220.8	.....	.....	.....	.....	16.85	306.1
55	16 41	15.81	544.30	13 47	17.67	192.5	.....	16.12	171.10
55 29 40	.....	.....	.....	.....	.....	.....	.....	.....	Infinite.
56 33 04	.....	.....	Infinite.	.....	.....	.....	.....	.....	.....
60	19 35	14.33	212.90	15 49	15.83	84.52	00 24	14.58	167.9

* Increasing at three-fourths per cent.
† Decreasing until about 1950 at one and four-fifths per cent. (present rate).
‡ Decreasing until 1893.

The mean R. A. and Dec. for 1891 are:

	Hrs.	Min.	Sec.		Deg.	Min.	Sec.
Alioth R. A..	12	49	13.91	Dec.....	56	53	03.9
Alcaid " ..	13	43	14.78	"	49	51	26 3
Mizar " ..	13	19	32.34	"	55	29	40.3
Polaris " ..	1	18	54.55	"	88	43	37.2

The difference in the R. A. of Mizar and Polaris is only 38s. over 12 hours, showing that the stars are almost exactly opposite upon the same great circle of the celestial sphere. They are in line 37s. after the culmination of Polaris. Next year the interval will be 17s. and in 1893 they are in line 4s. before culmination. The interval



This diagram shows the position of the Big Dipper stars at the upper culmination *s* of Polaris; Mizar being on line at its lower culmination, with Alioth to the east and Alcaid to the west at the extreme end of the handle.

a = the azimuth $S'OP$, $S''OP$ of Polaris,

y = the corresponding hour angle of Alioth and Alcaid, $= \varepsilon' P N$, $\eta' P N$,

and α = the hour angle $S' P O$, $S'' P O$, of Polaris. $O S N$. $O S \varepsilon'$, $O S'' \eta'$, are the arcs of vertical circles.

$P S = d$; Pm, $P \varepsilon'$, $P \eta' = D$; $PO = l$.

Twenty-eight minutes before this culmination Alioth at ε' was in line with Polaris at S' and O; 23 minutes subsequent, Alcaid at η' will be on the line $O S'' \eta'$.

$\alpha + y$ = the supplement of the angular difference between the *R. A.* of Polaris and the handle star.

will then increase for a few years at the rate of 2¼s. per year. The R. A. and Dec. of Alioth and Mizar are taken from the French Nautical Almanac. The annual increase or decrease of a is from 8″ to 15″ according to latitude. The annual increase of r is about $\frac{r}{200}$' (½ per cent.)

To find the hour angles x, y of Polaris and a Handle Star, when on the same vertical circle (see diagram 2).

o = zenith, l = co. lat., d = co-dec. of Polaris, D = co-dec. of the Handle Star.

From the diagram, the spherical triangles give

$$\frac{\sin x}{\sin y} = \frac{\sin D}{\sin d} \times \frac{\sin (l \mp d)}{\sin (l \pm D)} = m \qquad (4)$$

$l \pm D$, $l \mp d$ corresponding to the upper and lower culmination of Polaris or the lower and upper culmination of a Handle Star. $x + y$ = R. A. Handl Star — R. A. Polaris — 12 hours, is small with Alioth and Alcaid and nearly zero with Mizar.

$$\text{Let } x + y = c, \text{ then } \tan x = \frac{m \sin c}{1 + m \sin c}$$

$$\text{or, } x = \frac{mc}{1 + mc}, \text{ the angles being small.}$$

By eliminating the high powers of small quantities, the value of a, the corresponding azimuth of Polaris, reduces to

$$a = \frac{c}{\sin l (\cot D + \cot d)} \qquad (5),$$

or the upper position gives the same azimuth as the lower, although x and y vary.

Since x and y represent the hour angles of Polaris, and a Dipper Star corresponding to equal azimuths, y and x are proportional to the azimuth of the same stars for equal hour angles, or equal times near culmination, and $\frac{x+y}{y}$ = the ratio of the total azimuth of Polaris and the Handle Star to that of Polaris.

Let $\frac{x+y}{y} = r$, and A = the total azimuth; then the azimuth of Polaris is

$$z = \frac{A}{r}, \text{ for Mizar;}$$

$$z = \frac{A}{r} \pm a, \text{ for Alioth;}$$

$$z = \frac{A}{r} \mp a, \text{ for Alcaid.}$$

With Alioth and Alcaid when below Pole and west of Polaris or above Pole and east of Polaris, use the upper sign, but the lower sign with position reversed.

Table I has been calculated by (4) and (5). To find z, $A = 5°$, Mizar below, west of Polaris, Lat. 40°.

From the table, $r = 20$ (omitting the decimals)

$$z = \frac{5°}{20} = 0°.25 = 15'.$$

Now, the meridian must always lie between Mizar and Polaris, hence the 15′ is to be measured west from Polaris, or Polaris is 15′ east of the upper culmination. By the value of A in Table II the interval in time from culmination can be found.

Lat. 45°, A was measured 10°, Alioth above Pole and west of Polaris. $z = \frac{10°}{90} - 13' 32'' = -6' 52''$. Here the — sign shows that the meridian is not between the stars, but to the east of Polaris, Polaris being 6′ 52″ west of the lower culmination. When A = 13′ 32″ × 90, then $z = o$ at the lower culmination.

Lat. 45°, A was taken 10°, Alcaid above and west of Polaris. $z = \frac{10°'}{248} + 11' 11'' = 13' 39''$, the meridian being between the stars, or Polaris has passed 13′ 36″ east of its lower culmination. Table I should not be used when A exceeds 15°, to be within 1′ error.

With Mizar $z = \frac{A}{r}$ can hardly lead to any confusion

In Table II are given the values of A and r for different hour angles. The table has been calculated by (2). r remains nearly constant for 2 hours before and after the lower culmination of Mizar, but changes rapidly in high latitudes near the upper culmination and in many positions the hour angle must be regarded to determine the azimuth. If the hour angle were known, the value of z could be found by (1) or (3) or taken by interpolation from II. The azimuth when $H = 90°$ is about the same as at elongation; the error $= \frac{d^3 \cos^3 l}{2 \sin^3 l}$ is less than 2″ at Lat. 45,— and the difference in the hour angle = tan d cot l = d cot l = 1° 16′ at Lat. 45°; or elongation takes place about 10 minutes sooner after upper than lower culmination, the intervals being $5^h\ 54^m$ and $6^h\ 04^m$ respectively.

Examples with Mizar below Pole, Polaris above: With Table II an interpolation for A and r on account of latitude will generally be necessary, and when the angle differs too much from A, over 1°, if H exceeds 30°, an interpolation for r will also be necessary to correspond with the hour angle, or the observation may be continued until the angle differs but little from A; but for two hours on each side of the lower culmination the values of r will give nearly the same value for z, and no interpolation but for lat. is required. It will always be difficult to watch the stars until the azimuth exactly equals A, requiring many observations or considerable calculation; hence the advantages of r in Tables I and II.

Ex. 1. Lat. 40, the azimuth between Polaris and Mizar was found to be 23° 30′ to find z. The azimuth lies between H 30 and 45°, Table B.

$r = 20.72 + 0.65 \times \frac{6.00}{7.94} = 21.2$, $z = \frac{23°.5}{21.2} = 1°.11 = 1° 07'$.

Ex. 2. The azimuth was measured 15° 30′, Lat. 41. Interpolating for Lat.,

$$r = 20.72 - \frac{1.25}{5} = 20.47,\ H = 30$$

$$r = 20.37 - \frac{1.31}{5} = 20.11,\ H = 15°$$

$\frac{15°.5}{20.4}$ and $\frac{15.5}{20.1}$ will not differ more than 1′, and a farther interpolation for the hour is unnecessary.

Ex. 3. The azimuth was found to be 41° 30′, lat. 41° 30′. Interpolating for lat. 41° 30′,

$H = 75°$, $A = 38°.63 + 1°.67 \times \frac{3}{10} = 39°.13$; $r = 23.95$

$$- 0.91 \times \frac{3}{10} = 23.68$$

$H = 90°$, $A = 43°.56 + 2°.42 \times \frac{3}{10} = 44°.29$; $r = 26.22$

$$- 0.67 \times \frac{3}{10} = 26.02$$

Interpolating for the hour angle,

$$r = 23.68 + 2.34 \times \frac{2.37}{5.16} = 24.75$$

$$z = \frac{41°.5}{24.75} = 1°.68 = 1° 41'.$$

If the observation had been continued about a half hour, the azimuth increasing nearly to 44°.20, 26.0 could have been taken for r and second interpolation avoided, with greater accuracy when near the elongation of Polaris.

Mizar above, Polaris below Pole. When Mizar (or any of the handle stars) is near its upper culmination, it will be so near the zenith north of lat. 30, as to be beyond the field of an ordinary transit. Owing to the equality in azimuths before and after the elongation of Mizar, the position of the star must be carefully noted or H calculated. There can be no ambiguity near its upper and lower culmination, or for six hours each side of its lower culmination. No one should have a watch liable to vary over 15 m., and H determined by Table C within 15 m. will determine whether A is before or after the elongation of Mizar. An observation at or close to the elongation will make $z = \frac{A}{r}$ indeterminate.

The direct solution of z in terms of A, l, d and D runs into an equation of high degree, but z can be found by assuming the time and calculating the corresponding value of H by Table C. Let Z', z_1, be the corresponding azimuths for a Handle star and Polaris calculated by (2)

$\frac{Z' + z_1}{z_1} = r$, $z = \frac{A}{r} \pm a \cos H$, a being zero with Mizar. Should $Z' + z$ differ much from A, another assumption for H will be required, then interpoiate for r.

TABLE II.

Values of A, z and r for Mizar and Polaris, Polaris above and Mizar below the pole; z = azimuth of Polaris; A = azimuth of Mizar + that of Polaris; $r = \frac{A}{z}$; H = the time in hours or degrees from culmination.

	$H = 15°$			$H = 30°$			$H = 45°$			$H = 60°$			$H = 75°$			$H = 90°$			Approximate value of H at the elongation of Mizar.	Corresponding value of A. A close to its maximum south of lat. 50°.	Corresponding value of z.
	1 hour before or after the culmination of Polaris.			2 hours.			3 hours.			4 hours.			5 hours.			6 hours. (5h. 59m. more precise.)					
	A	z	r	A	z	r	A	z	r	A	z	r	A	z	r	A	z	r			
30°	8°.83	0°.385	22.90	17°.19	0°.743	23.13	24°.72	1°.049	23.56	31°.11	1°.281	24.29	36°.22	1°.474	25.44	39°.90	1°.470	27.14			
35	8.84	0.408	21.65	17.28	0.787	21.94	25°.00	1.111	22.49	31.71	1.357	23.35	37.29	1.507	24.74	41.55	1.554	26.74			
40	8.92	0.438	20.37	17.50	0.845	21.72	25°.44	1.191	21.37	32.55	1.453	22.40	38.63	1.613	23.95	43.56	1.661	26.22			
45	9.07	0.476	19.06	17.87	0.918	19.47	26.11	1.293	20.20	33.65	1.586	21.22	40.30	1.749	23.04	45.98	1.800	25.55			
50	9.31	0.526	17.70	18.38	1.013	18.14	27.01	1.427	18.93	35.04	1.738	20.16	42.36	1.926	22.00	48.90	1.980	24.70			
55	9.69	0.593	16.27	19.09	1.141	16.73	28.18	1.605	17.75	36.79	1.953	18.84	44.86	2.161	20.76	52.37	2.219	23.60			
60	10.08	0.685	14.73	20.02	1.317	15.20	29.67	1.851	16.03	38.98	2.248	17.34	47.92	2.484	19.29	56.48	2.545	22.19			
	Values of A, z and r, Polaris below, Mizar above pole. The difference in time between the upper and lower positions is 12h. (11h. 58m. 02s. more precise). Values of A and z in degrees and decimals.																		H	A	z
30	18°.79	0°.376	50.0	31°.87	0°.727	43.87	38°.98	1°.030	37.84	41°.88	1°.265	33.11	41°.91	1°.415	29.60				66°.61	42°.18	1°.34
35	22.59	0.395	57.1	36.50	0.767	47.60	43.05	1.087	39.60	45.07	1.336	33.73	44.28	1.495	29.62				61°.23	45.09	1.35
40	28°.09	0.422	66.5	42.69	0.818	52.19	48.13	1.160	41.49	48.94	1.426	34.32	47.11	1.597	29.50				54.78	50.02	1.34
45	37.27	0.456	81.7	51.10	0.882	57.86	54.45	1.253	43.45	53.59	1.542	34.75	50.51	1.729	29.21	The same as above.			46.58	54.52	1.29
50	46°.98	0.500	93.7	62.45	0.968	64.51	62.27	1.375	45.29	59.18	1.693	34.96	54.55	1.900	28.71				35.00	63.07	1.12
55	81.06	0.557	145 4	77.03	1.080	71.32	71.68	1.535	46.70	65.76	1.892	34.75	59 32	2.126	27.90				11.02	81.34	0.41
60	113.47	0.635	176.6	93.81	1.232	75.95	82.50	1.753	47.06	73.38	2.163	33.92	64.90	2.434	26.67				0.00	180.0	0.00

A = the angle measured on the plane of the horizon between stars, and always = $z' + z$ south of lat. 50° 30'.

Let z' = the azimuth of Mizar, then north of lat. 55° 30'. $A = 180° + z - z' = 180°$ at culmination. Were a backsight taken on Mizar as supposed in Table A, the angle becomes $z' - z = 0$ at culmination, Mizar being south of the zenith.

Elevated Railway; Liverpoo', England.

The elevated railway along the docks at Liverpool, England, is the first railway of its kind in England, the various masonry elevated lines in and around London being merely the entrances of the trunk lines into the city, while the "Liverpool Overhead Railway," as it is called, is intended for local passenger traffic and for freight traffic to the numerous docks and warehouses. As long ago as 1852 Mr. JOHN GRANTHAM, consulting engineer to the Mersey Docks and Harbor Board, proposed a scheme for a high level railway, which embodied several of the ideas that have lately been put forward in connection with some of the schemes of rapid transit in New York. The project was for a line about 4 miles long, carried on iron columns 20 ft. high, the space underneath to be used for sheds, and a roof or warehouse built over the railway. There were to be 6 tracks, 2 for passenger and 2 for freight service, the 2 nearest the docks being used as side tracks. The line was to connect with the several railways entering Liverpool, and with the large public and private warehouses, and lines were to run out on both sides of each dock, either on an elevated structure or on the ground level, in which latter case the cars were to be raised and lowered by hydraulic elevators. On the structure was to be a complete system of hydraulic cranes. In 1877, the attention of the Board was called to the fact that the omnibuses on the surface railway took 42 minutes to run 3¾ miles, owing to the heavy street traffic, and it was proposed to have a single track line, carried on columns, with 9 stations, and operated by light locomotives, the running time to be 20 minutes. In accordance with a resolution then passed Mr. G. F. LYSTER, Engineer in Chief, prepared plans for such a line, with columns 50 ft. apart and a headway of 13 ft. 6 ins.; the estimated cost was about $750,000, or $625,000 for the structure and $125,000 for equipment. The necessary legislation was obtained in 1878. Two spans of 50 ft. were erected as a specimen, and proposals were invited in 1879, but then the matter dropped. The Board of Trade refused to authorize the construction of a single track line, and it was thought a double track line would be too expensive for the amount of traffic expected. In 1880 Mr. LYSTER prepared plans for a new class of structure, the estimated cost (including rolling stock) being $2,200,000 for single track, $2,650,000 for double track, with open floor, on the "American" system, and $2,780,000 for double track, with trough floor system. In 1882 legislation was obtained for a double track line, but the matter again rested until 1888, when authority was obtained for the construction of the line by a company to which it was to be leased for operation. The Liverpool Overhead Ry. Co. was organized in 1889. The engineers are Sir DOUGLAS FOX, M. Inst. C. E., and Mr. J. H. GEATHERD, M. Inst. C. E. Mr. FRANCIS FOX, M. Inst. C. E., is Resident Engineer. The cost is estimated at $2,000,000. The railway will be a double track line of standard gage, about 6½ miles long, with stations at short intervals and frequent trains. It will be a plate-girder viaduct with through spans. It will be operated by electricity. The Board stipulated for the right to subscribe for $500,000 of the capital stock of the company, and will lease the line rent free until a dividend of 6% is earned, after which it is to receive $5,000 per annum, the surplus profits being divided between the Board and the company.

The following particulars are from an article in *Industries*, and it will be seen that the style of construction is very similar to that of some of the later types of elevated railways in this country, although it is more common here to use deck rather than through structures.

The viaduct consists of plate girders 25 ft. apart, resting on built steel columns at normal spans of 50 ft.; at various places—such as at the entrances to docks—the spans are larger than 50 ft. (75 to 100 ft.) to suit the requirements of each particular case, the depth of the girders varying accordingly. The clear headway underneath averages about 16 ft. Between the main girders are fixed Hobson's arched flooring plates to carry the lines of rails. [ENGINEERING NEWS, Dec. 28, 1889.] The chairs for the rails may be attached direct on the crown of the plates, as has been done to carry the traveling gantry for erection, but for the permanent rails they will be attached to longitudinal timber sleepers secured to angle iron cleats riveted to the plate crown. The arch plates are of steel, and they make a very strong and rigid floor; they are ⅜-in. thick, bent to a radius of 12 ins. at the branches and 36 ins. at the crown. The plates are riveted together at the springing, a T-bar 4½ × 3½ × ⅞ in. intervening, and make a floor 1 ft. 3 in. deep, the weight per foot of net area covered being 24.48 lbs. The T bars are 2 ft. 6 ins. apart c. to c.; that being an exact subdivision of the span makes a convenient pitch for the flooring plates. The main girders have no special features, beyond being well designed plate girders of the ordinary single-web type; they are not continuous, each span being independent. Each column consists of two steel channel bars riveted to two steel plates, forming a rectangular column of strong section, the flanges of the channel bars being outside for convenience of riveting; they are let into a cast iron socket plate bedded in concrete below the level of the ground, on which are fixed the cast iron segmental kerbs to protect the column from wheel traffic. The kerbs are hollow, and are afterward filled with strong cement concrete, thus forming a base for the columns and an efficient protection from wheels. The columns are tied at the top with a light lattice girder of T bars for top and bottom members, and flat bar bracing, the depth of the girder being increased at the columns. The lattice tie girders are only used when the line of the main girders is straight; when the girders are not in line, as is required at the curves in the railway, two web-plate girders are used in place of the single lattice, a plate being riveted to the top to carry the ends of the main girders, and to make up the space consequent upon the ends of the girders not abutting. This space between the ends of the outside girders is filled, of course, to suit the curve of the railway, and the plate bracing girders are made accordingly. The foregoing is a brief description of the typical construction of the railway, but there are several points along the length of the line which demand special mention.

Near the Wellington Dock the railway level crosses the high level railway leading to the Dock Board coal tips; and, as the railways are nearly of the same level, the difficulty has been overcome by taking the overhead railway underneath the other one by a rather sharp incline on either side, the rails being laid on an embankment instead of girders at the bottom of the dip. At two points, where the normal clearance or headway would not be sufficient to allow large boilers and other such articles to be taken to the large cranes fixed on the quays, special bridges have been erected to allow a free passage through the railway. These bridges have been designed by Mr. F. HUDLESTON, Assoc. M. Inst. C. E., chief engineer for the contractor, and are of novel construction. They may be briefly described as follows: There are two side girders, fitted complete with arched flooring plates in a similar manner to the rest of the viaduct, but in addition to the bearing at the end of the girders there is a pivot at the point underneath the girders dividing them into long and short legs. To the latter are attached hydraulic cylinders by means of a connecting rod, and by practically one operation the end bearing of the short leg is withdrawn and the latter drawn down so as to tilt the girders and platform. The operation is very simple and the bridges work well, being opened and closed in a very short space of time.

At another point there has been a double difficulty to contend with, for the overhead railway not only crosses the entrance to the Stanley Dock, but the bridge for the ordinary road traffic crosses at the same place; it was therefore necessary to have a double movable bridge, the top part for the railway and the bottom for the road traffic. Mr. HUDLESTON has again very cleverly overcome the difficulty by designing a bridge which is ingenious and unique. The main bridge consists of two lifting cantilevers meeting at the centre, on the top of which is fixed

the arched plate flooring to carry the rails. The cantilevers swing on a centre pivot and rollers at the tail end. When not swinging, the weight of the cantilevers etc., is taken off the rollers, and a leg at the front takes its bearing and share of the weight. Before swinging, the weight is taken off the leg, and the rollers are brought to bear on the roller path, and, by hydraulic pressure, the whole cantilever turns. Now, as the bridge for the road traffic is at a much lower level than the overhead railway, for small craft it would be sufficient to raise or swing the lower bridge only, and this would not stop the traffic of the railway. Mr. HUDLESTON, therefore, made the portion of the bridge to carry the road traffic in the form of a drawbridge, and this he suspended from the cantilevers with links at the end and a pivot at the heel. Chains are attached to the end of the leaf of the drawbridge; and by a simple hydraulic ram or cylinder either one leaf or both can be raised to allow the craft to pass through the dock entrance. If a large vessel has to pass through, the cantilevers are swung round, carrying, of course, the drawbridges with them. It may be sufficient to open one cantilever only for a small vessel, the bridge being thus capable of working under four conditions, which will materially affect the cost and facility of working.

The greater part of the work is being done on the northern section, to get it ready for traffic. Progress is also being made on the southern section, the foundations for which are to be completed this year. Serious consideration has been given to the question of motive power, and it has been decided to adopt electricity, as being cleaner, safer and more economical in working than steam, although the first cost will be higher. The central station will be located close to the line, and the current will be conveyed by a third rail between the track rails. A contract for the complete electrical equipment has been awarded to the Electric Construction Co., of Wolverhampton, and that company will work the line for 2 years at a fixed sum of 7 cts. per train mile, so that economical working will be insured. This sum does not of course include station staff, signaling, etc. It is expected that the entire line will be ready for operation next spring.

The Comparative Merits of Various Systems of Car Lighting.

IX.

THE PINTSCH COMPRESSED GAS SYSTEM—THE PLANT ON THE CAR.

The essential features of the plant placed upon each car lit by the Pintsch gas system are the reservoir for holding the compressed gas, the "regulator" for reducing its pressure to the very low point required for burning and the system of gas piping, burners and lamps. All these parts are shown in the accompanying illustration, Fig. 1, a portion of the car being cut away to show the location of the parts of the plant beneath the car floor.

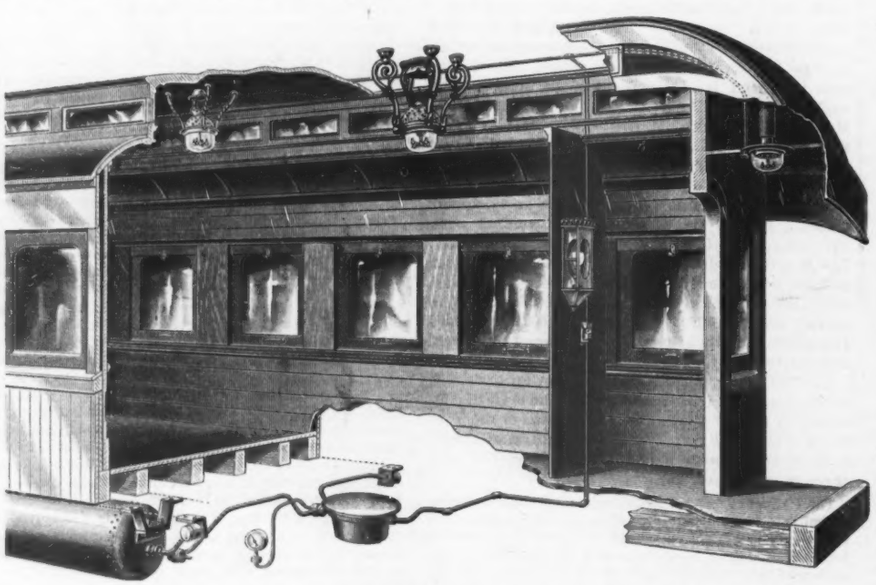


FIG. 1. PINTSCH COMPRESSED GAS LIGHTING PLANT, ATTACHED TO CAR.

It will be seen that cocks for attaching the filling hose for replenishing the reservoir are placed on each side of the car, so that on whichever side the line of distributing pipe is located, the car filler can connect the hose without crawling under the car. A pressure gage is attached to the filling pipe near the reservoir (not exactly in the position shown in the drawing). By consulting this gage, the pressure in the gas in the reservoir and the amount available for burning at any time can be ascertained.

The reservoirs used on the car are made of various sizes, from 6 ft. to 9 ft. 6 ins. in length and 16½ ins. to 20½ ins. diam., and of special sizes to order when desired. In ordinary passenger service a single reservoir is all that is required; but where very long runs are to be made, two or more reservoirs may be attached to the car. For example, the Pullman cars running from Chicago to New Orleans (burning nearly a dozen lamps) have four large reservoirs, or enough to last an ordinary car with five four-flame lamps, burned four hours per day, for a continuous service of 17 days. In ordinary passenger service, however, the additional weight and cost of even one extra tank are not often incurred. A single tank, 9 ft. 6 ins. × 20½ ins., holds, when filled to 10 atmospheres, 212.5 cu. ft., or enough to supply an ordinary car, fitted as above, for four days' service, burning the lamps four hours per day.

The reservoirs used in this country are shown by Figs. 1, 2 and 3. They are made of mild steel ¼ in in thickness. The cylinder is made of a single sheet of metal with a double riveted lap joint. The heads are $\frac{7}{16}$-in. steel, flanged, and fitted in the ends of the cylinder with the ends of the convexity outward. In this way the outward pressure on the heads tends to counteract the outward pressure on the cylindrical shell, whereas if concave heads were used, the two forces would both tend to burst the shell at the ends.

In making the cylindrical shell, after the holes are punched for the rivets and it is bent into shape it is dipped into a bath of tin. The rivets are also tinned and are driven cold; the longitudinal seam is then brazed. The heads are flanged and punched and the carrier brackets are riveted on (see Fig. 3), and they are then tinned. The heads are fastened in the ends of the cylinders by tap bolts, as shown, and all the joints are carefully soldered. These precautions have been found necessary to make the reservoir absolutely gas-tight under the pressures employed.

Concerning the strength of the cylinder, the tenacity of the mild steel employed may fairly be set at 60,000 lbs. per sq. in. On a cylinder of 20 ins. internal diameter, subjected to a pressure of 150 lbs. per sq in., the tensile strain per lineal inch on each side will be 1,500 lbs. As the metal is ¼ in. thick, the working strain on the solid metal is only 6,000 lbs. per sq. in. If we take the strength of the double riveted lap

FIG. 2. CAR RESERVOIR FOR COMPRESSED GAS, PINTSCH SYSTEM.

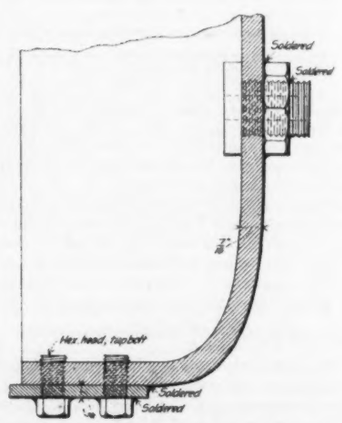


Fig. 3. Detail of Joint Between Shell and Head of Car Reservoir.

joint as 60% of that of the solid plate, we have 9,000 lbs. as its ultimate strength, or a factor of safety of 6. All reservoirs are tested to 250 lbs. pressure or 100 lbs. more than the highest pressure in service.

In English practice the heads of the car reservoirs are made concave, and are welded in; but besides the loss of strength already noted with this construction, there is an additional disadvantage due to the loss in capacity for a given weight and a given space occupied.

We may note in this connection that the storage tanks used at the gas works and for carrying gas on tank cars are examples of high excellence in metal working. They are 20 ft. long and 4 ft. 2 ins. in diameter, and every seam is welded. In their manufacture the separate rings are first welded, which of course presents no especial difficulty. Each ring is then slightly expanded at one end and enlarged at the other, and the cylindrical portion of the holder is then made by welding together these separate sections. The most delicate operation, however, is welding in the heads, where the only resistance to the welder's hammer is that due to the stiffness of the sheet. These holders are all made at the works of Julius Pintsch in Berlin. The reason for the use of welded instead of riveted seams is, of course, to avoid all leakage.

One of the most important features of the Pintsch system is the regulator, by which the pressure of the gas in the pipes leading to the lamps is maintained at ½ oz., no matter whether the reservoir be full of gas at 150 lbs. pressure or nearly exhausted. Fig. 4 is a section of the regulator. It consists of an iron, basin-shaped chamber, closed at the top by a flexible diaphragm of prepared leather. The space

on the lower side of this diaphragm is filled with gas at ⅛ oz. pressure, which tends to raise the diaphragm, but motion is opposed by the flat spring connected to the bar supporting the center of the diaphragm. The valve which admits the compressed gas from the reservoir is controlled by this bar, as seen in the drawing, so that when the pressure falls the valve opens and admits more gas from the reservoir.

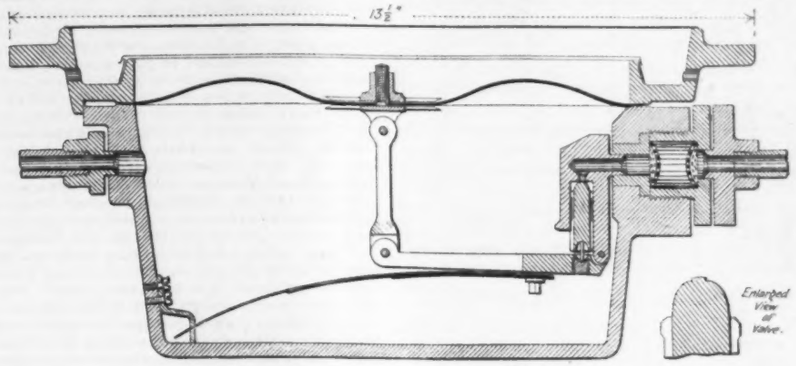


FIG. 4. SECTION OF PINTSCH REGULATOR.

The important feature of the regulator is the valve, an enlarged section of which is shown in the lower right-hand corner of Fig. 4. To make a valve which shall be absolutely gas-tight against pressure up to 150 lbs. is the problem, for if the valve allows the gas to leak past it ever so little, the pressure will be gradually raised in the pipes leading to the burners. The construction adopted to make the valve absolutely gas-tight is as follows: The opening in the valve seat is only $\frac{3}{32}$ in. diameter. The valve seat is of hard composition metal. The valve is made of a soft alloy and has a parabolic shaped head. When the valve is forced to its seat this soft alloy yields slightly, and a tight joint is formed. In the enlarged section shown on Fig. 4 we have slightly exaggerated the shoulder which is formed on the valve where it comes in contact with the seat after being in use for some time.

To prevent any scale or particle of dust or grit being carried along with the gas and interfering with the closing of the valve, a filter is placed just back of the valve, consisting of brass nettings, between which is placed fibrous material.

The regulator is warranted for five years by the Pintsch Co., and some of them have been in use for 16 years on the railways of Germany without repairs or interference. It is adjusted once for all when made to give the ⅛ oz. pressure used in the distributing pipes, and needs no further adjustment. The fact that differences of pressure in the reservoir can have but an infinitesimal effect on the pressure of the gas in the pipes beyond the regulator, may be appreciated by comparing the areas and leverages of the two fluid pressures. The area of the valve-port for the compressed gas is to the area of the regulator diaphragm as 1 to about 9,000. Their relative leverage is as 1 to 25; hence a difference of pressure of 150 lbs. per sq. in. in the compressed gas will be balanced by a difference of pressure per sq. in. on the diaphragm of $\frac{150}{25 \times 9{,}000} = \frac{1}{1500}$ lb. or about $\frac{1}{100}$ oz.

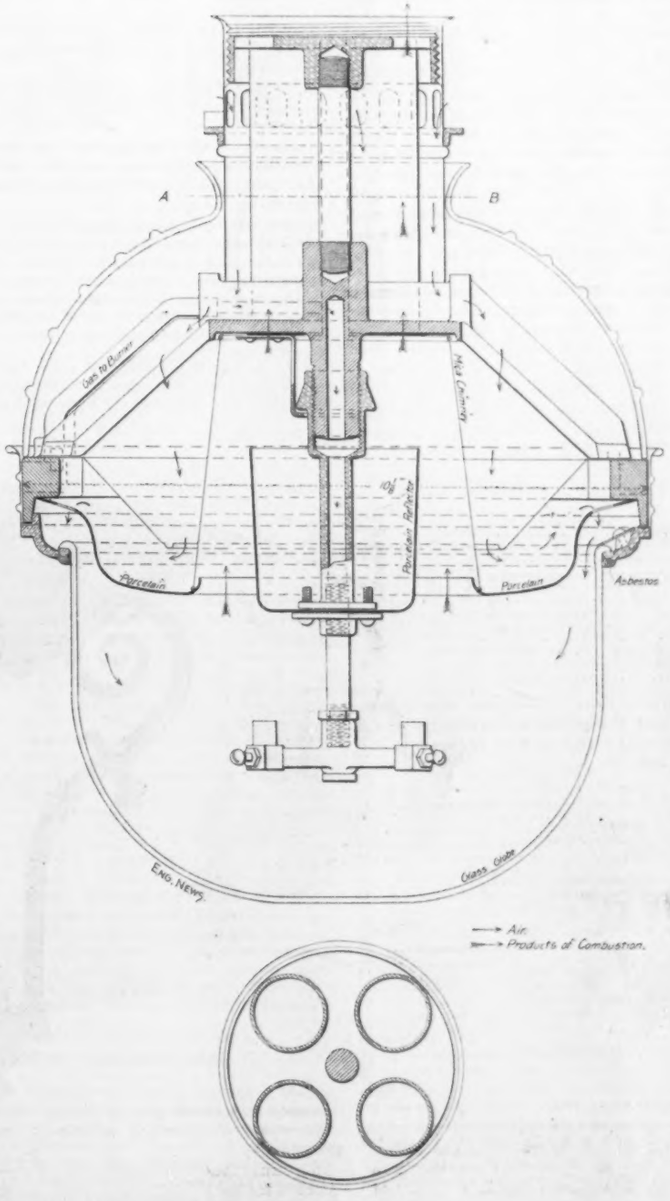
The pipes leading from the reservoir to the regulator and to the filling valves are jointed by tinning the threads and soldering after screwing the pipes together; or where flange joints are used at the junction with filling valves, regulator, etc., a compound rubber and lead gasket is used, the rubber making a tight joint and the lead serving to protect the rubber to a considerable extent from the action of the gas.

From the regulator onward, the gas being under very low pressure, the same care is not necessary in making the joints and an ordinary ½ in. iron gas pipe is used. As seen in Fig. 1, this pipe leads from the regulator to a point underneath the closet, thence upward through the closet to the roof, and thence along the roof of the car, branches being taken off by T connections to supply each lamp. A main controlling cock is placed in the closet and may be turned either to shut off all gas from the car, to give the full opening of the pipe, or to admit the gas through a small by-pass. The last position is the one in which it is placed when the lamps are to be lighted; this avoids smoking the reflector plates of the lamps, which would sometimes occur with the full head of gas when the bowl was open and the wind was blowing. After lighting the lamps the cock is turned to the wide-open position.

Fig. 5 shows a section of the standard lamp of the Safety Car Heating & Lighting Co. The gas is led down to the burner from the roof pipe through one of the hollow supporting standards. From here it passes to the center of the lamp and down to the burners. The reflecting surface above the burners is of white porcelain. A part of the light is reflected upward through the mica chimney and the porcelain shade and lights the head linings. The products of combustion pass up inside the mica chimney and then through four tubes, as shown by the section *A B*, to an exit at the top. The air to supply the flame is taken in at the elliptical openings near the top of the lamp, and in its passage downward, around the tubes just referred to and over the mica chimney, is considerably heated.

The lamps are made with either two, four or six-flame burners. A check screw with lock nut is attached to each burner; and the height of flame is adjusted by this when the lamps are put up, after which it should not be interfered with.

The question of amount and quality of the light from the lamp we shall discuss in a future article.



Section A-B.

FIG. 5. SECTION OF STANDARD LAMP OF SAFETY CAR HEATING & LIGHTING CO.

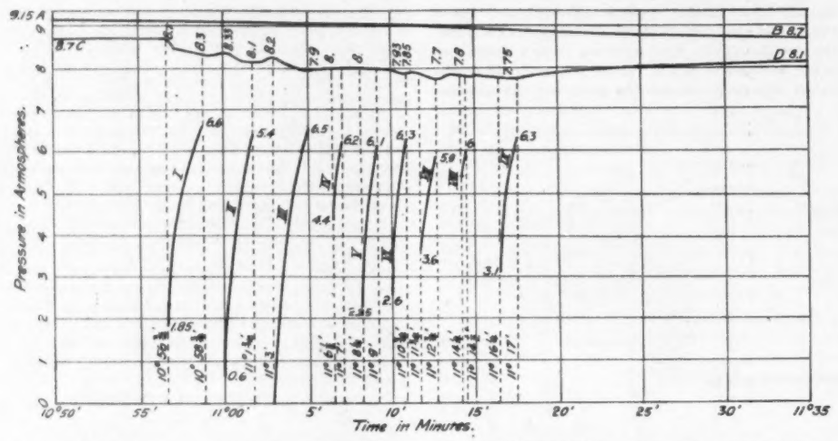


FIG. 7. DIAGRAM OF CHANGE OF PRESSURE IN STOREHOLDERS (A B) AT GAS-WORKS AT HAINHOLZ AND IN ACCUMULATOR AT HANOVER (C D) WHILE FILLING CARS.

Curves I to IX show pressures in car reservoirs. Capacity of Storage Reservoir, 250 cu. ft. Capacity of Accumulator, 250 cu. ft. Capacity of Car Reservoir, 32 cu. ft. Size of Pipe, 16 mm. Length of Pipe, 7,873 ft.

in connection with the photometric tests made by Mr. W. D. B. PENNIMAN.

The lamp globe and shades are packed with asbestos to prevent rattling, and especial care is taken with all joints to prevent them from becoming loose with the constant jar of service. Heavy springs are placed on the gas cocks controlling the lamps as seen in Fig. 6, to prevent them from becoming loose.

In applying the apparatus to a car, pains should be taken to remove all scale and dust from the interior of the pipes by jarring them and blowing through them. Even with this precaution, however, some scale is likely to work loose in the pipe when the car is first put in service. It is recommended, therefore, to disconnect the pipes after the car has been running for a month or so and blow them out thoroughly.

According to data furnished us by the Safety Car Heating & Lighting Co., the Pintsch lighting system is now in use on over 38,000 passenger cars, divided among the different countries, as follows:

Country.	Railways.	Cars equipped.
Germany	39	21,300
France	7	3,300
Denmark	2	45
Sweden	2	230
Switzerland	4	260
Italy	4	1,105
England	15	6,100
Holland	4	767
Russia	11	631
Servia	4	104
Austria	7	1,560
United States	30	2,003
Brazil	2	310
Argentine Republic	4	620
Australia	2	15
Total	128	38,350

In the United States the companies using the Pintsch system and the number of cars equipped by each is as follows:

Companies.	Cars.
Baltimore & Ohio	17
Boston & Albany	35
Central Railroad of Georgia	25
Central Railroad of New Jersey	222
Chesapeake & Ohio	15
Chicago & Erie	48
Chicago & Northwestern	200
Cincinnati, Hamilton & Dayton	11
Delaware, Lackawanna & Western	18
Denver & Rio Grande	83
East Tennessee, Virginia & Georgia	25
Illinois Central	10
New York & New England	12
New York Central & Hudson River	62
New York, Lake Erie & Western	309
New York, New Haven & Hartford	63
New York, Providence & Boston	27
Old Colony	36
Rio Grande Western	40
Rome, Watertown & Ogdensburg	11
Wabash	11
West Shore	111
Pullman Palace Car Co.	209
Wagner Palace Car Co.	195

The balance, making up a total of 2,003, on the Canadian Pacific, Chicago & Eastern Illinois, Cleveland, Cincinnati, Chicago & St. Louis, Louisville, New Albany & Chicago, Philadelphia & Reading, Richmond & Danville, Third Ave. Cable Road, Cairo Short Line, Long Island R. R. and Chicago, St. Paul, Minneapolis & Omaha.

Pintsch gas-works are in operation, and gas is supplied at the following depots:

Boston	4 depots.	Cincinnati	2 depots.
Stonington, Ct.	1 "	Chicago	5 "
New York City	2 "	Savannah, Ga.	3 "
Jersey City	2 "	St. Louis	Union d'pot
Hoboken, N. J.	2 "	Atlanta, Ga.	" "
Weehawk'n, N. J.	1 "	Denver, Col.	" "
Syracuse, N. Y.	2 "	Ogden, Utah	" "
Marion, O.	1 "	Minneapolis	1 depot.

Concerning the plant attached to the car we find the following in the paper by Mr. HUNTER before the Institution of Civil Engineers, from which we have before quoted:

At the station of the Caledonian Ry., in Glasgow, distributing pipes are laid so that trains can be charged with gas while standing at the station. Pipes are also laid to the carriage shed ½ mile from the works, and carriage can be charged there before being taken out and marshaled. It takes 3 minutes to couple the hose and charge a standard carriage carrying 6 lamps, if they be empty, but this is seldom the case.

Each carriage is provided with one or two recipients or cylinders of a size proportionate to the number of lamps it carries. The recipients are made of $\frac{5}{16}$-in. steel plate, carefully bent. The joints are both riveted and soldered and the flanged ends are then fitted in and fastened by screws and soldered over.

It was at one time imagined that dangerous explosions might result from the presence of so much gas under each carriage in the event of a railway accident. In order to settle this point, an experiment was made with a recipient 6 ft. in length and 16 ins interior diameter, made of ¼-in. plate. This recipient was filled with gas at a pressure of 6 atmospheres (90 lbs.), and placed under a scaffolding, supported at its ends, with a fire on each side. A weight of 400 lbs. was dropped on it from a height of 15 ft., the weight falling exactly on the riveted seam. At the first blow it was merely bent in, and became slightly loosened about the rivets. A pointed piece of iron was then placed on the recipient, and the weight allowed to drop as before. This made a hole 5 ins. in diameter; and, in opposition to the effects which would have been exhibited by the explosion of a steam boiler, the gas simply escaped from the hole, and being ignited by the fire, burned with a high flame. There was nothing of the nature of an explosion, and scarcely any noticeable concussion of the air at a few paces distant. The test sufficiently proved the comparatively harmless nature of the small volume of gas inclosed in the recipient, and that the gas can escape only through external power or an accident. This has been confirmed in several cases where a broken tire made a hole in the recipient, the gas escaping harmlessly into the air before the train had come to a standstill. . . . . .

The recipients are charged to six atmospheres (90 lbs.) for 36 hours' burning; and no carriage is allowed to leave the Glasgow stations with a lower pressure in the recipients than two atmospheres, or enough for 12 hours' burning.

The paper by Mr. AYRES on this subject, from which we have before quoted, was devoted more to the use of compressed gas for lighting buoys and beacons. We find, however, the following concerning its application to car lighting:

The application of compressed oil gas to the lighting of railway carriages was first tried in the year 1871 with satisfactory results in Germany, on the Lower Silesian Railway, and in England in 1876, on the St. John's Wood trains of the Metropolitan Ry. The Great Eastern Ry. was the next to adopt it; the Metropolitan Ry. Co. definitely adopted it for the whole of its rolling stock a few weeks later, other companies quickly following suit. The gasholders are attached either to the roofs or to the underframing of the carriages, and are charged to a pressure of 6 to 8 atmospheres. Taking one of the London & Northwestern Ry. Co.'s 6-wheeled, first-class carriages as an example, such a carriage carries two gasholders, placed side

FIG. 6. PERSPECTIVE VIEW OF STANDARD LAMP (From Photograph).

by side longitudinally, having a collective capacity of 27½ cu. ft. There are seven lamps, burning each 0.4 cu. ft. of gas per hour. A carriage thus fitted will run from Euston to Aberdeen and back, a distance of 1,080 miles, the lamps burning continuously for 33 hours with only one change of gas, the gasholders being charged to a pressure of about 120 lbs. per sq. in., more or less. On arriving back at Euston there is usually about 20 lbs. pressure remaining in the holders. The number of carriages so fitted to date (April, 1888) is 1,462. The cost of the gas delivered into the gasholders, including interest on capital and depreciation of plant, is about 8s. 5d. ($2.02) per 1,000 cu. ft. With the lamps burning 0.4 cu. ft. per hour used on this road, this makes the total cost of the gas burned in each lamp per hour only .040d. ($.0008).

DISCUSSION.

Mr. JOSEPH TOMLINSON, JR., presented a detailed table of figures of the cost of lighting the trains on the Metropolitan Ry. The system of lighting in use up to 1876 on that road was ordinary coal gas.

The application of the Pintsch system began in 1871, but was not completed until 1876. As the directors would not invest any capital in making the change, he offered to make it out of revenue if they would give a "suspense account" while the change was taking place. This having been agreed to, he had paid off the whole cost of construction in about three years out of savings, the whole amount being about £9,000. The only charge that went to capital was the gas-works, buildings and fittings, and trucks and holders for distributing the compressed gas. The cost per train mile for train lighting on the Metropolitan Ry., in the years 1873 to 1875, when ordinary coal gas was used, was as follows:

Half year ending	June, 1873	1.50d.
" " "	Dec. "	1.44d.
" " "	June, 1874	1.59d.
" " "	Dec. "	1.65d.
" " "	June, 1875	1.52d.
" " "	Dec. "	1.54d.

After the introduction of the Pintsch system the cost of lighting per train mile was:

Half year ending	June, 1882	0.93d.
" " "	Dec. "	0.87d.
" " "	June, 1883	0.83d.
" " "	Dec. "	0.83d.
" " "	June, 1884	0.87d.
" " "	Dec. "	0.91d.

MISCELLANEOUS NOTES.

Fig. 7 is a diagram showing the length of time taken to fill several cars and the fall of pressure in the storage tank and in the accumulator. The storeholder at the gas works at Hainholz was 18 ft. 4 ins. long and 4 ft. 1½ ins. in diameter, making its capacity about 250 cu. ft. From it a pipe of 16 mm. diameter (⅝ in. nearly) led to the car-filling tracks at Hanover, a mile and a half away, where an accumulator of the same size and capacity as the storeholder was placed. The car tanks on each car had a capacity of about 32 cu. ft.

Since our article descriptive of the gas-making plant was published (in our issue of Aug. 22) we have received some further particulars concerning the first American works for which figures were given. The total cost of gas in the car tanks per 1,000 cu. ft. was there shown to have reached the high figure of $4.20 per 1,000 cu. ft. in the seven months from July 1, 1890, to Jan. 31, 1891. Besides the fact that the building is designed for a considerably larger plant than is now in operation, which we before alluded to, and the very low yield of gas per gallon of oil, pointing to inefficient operation in the works, we learn that the pipe distributing lines and the filling valves have not been properly looked after, and the result has been a large loss by leakage, which, however, has recently been remedied. That the above high cost of the gas is due to inefficient operation is pretty conclusively proved by comparing the cost per 1,000 ft. on board cars with the cost on three other railways each located within 10 miles of the first-mentioned works.

Name of railway.	Total cost of gas per 1,000 ft. on board cars.
"A" (Seven months ending June 31, '91)	$4.206
"B" (Three months of 1891)	2.10
"C" (Six months ending July 1, '91)	2.65
"D" (Six months ending Jan. 1, '88)	2.11
"D" (Six months ending Jan. 1, '89)	2.095

In a later article devoted to a comparison of the costs of the different system of car lighting we shall discuss more fully the cost of application and maintenance of the Pintsch system, together with the others described, and also the comparative safety of the different systems.

AN ELSINORE-HELSINGBORG SUBAQUEOUS TUNNEL is proposed to be located under the sound separating these two points. As now planned it would be built of iron tubes in lengths of 100 ft. resting on submerged iron piers filled with concrete. The tubular portion would be about 4 miles long and sunk low enough to allow ships to pass over it. The estimated cost is about $3,500,000. The tube would have an outer and inner shell braced together and filled with concrete. And while the foreign despatches do not say so it is doubtless the same plan as that illustrated and described in our issue of Feb. 28, 1891, from data furnished by Mr. FREDERICK E. STROM, the inventor, and a Swedish engineer of repute.

THE ELEVENTH U. S. CENSUS, as far as the first 500 pages are concerned, will be in the hands of the Public Printer by Sept. 15, says Superintendent of Census ROBERT P. PORTER. The last of the 62,622,250 cards was received on Sept. 1. As each of these cards was punched 17 times since Feb. 28, 1891, the aggregate number of holes which represent the questions asked by the enumerators is 1,064,578,250. Mr. PORTER expects to have several completed volumes ready for Congress in the coming winter.

PERSONALS.

Mr. H. D. MOFFATT has tendered his resignation as President of the Denver & Rio Grande R. R. Co.

Mr. JAMES L. COMSTOCK, civil engineer and surveyor, died this week at Richfield Springs, N. Y., aged 75 years.

Mr. S. S. NEFF has been appointed Superintendent of the Fairhaven & Southern R. R., vice Mr. A. J. BORIE, resigned.

Mr. GEORGE M. ADAMS has been appointed Railroad Commissioner of Kentucky, vice Mr. J. T. HAGER, resigned.

Mr. H. MCCALLUM has been appointed City Engineer of Marinette, Wis., and has charge of considerable block paving and sewerage work.

Mr. J. S. B. THOMPSON, Superintendent of the Virginia Midland and Washington and Ohio divisions of the Richmond & Danville system, has been appointed Assistant General Manager.

Mr. JOHN BOGART, M. Am. Soc. C. E., the present State Engineer, is a candidate for renomination. He is a strong candidate, as his administration of the office for two terms has given general satisfaction.

Mr. ENOCH G. SWEAT, a well known railway contractor, died on Sept. 1 at Woonsocket, R. I., aged 66 years. Mr. SWEAT built part of the Boston & New York railway, near Woonsocket, in 1852. From 1888 to 1889 he was General Manager of the Upper Coos railway, now part of the Maine Central system.

Mr. DUGALD C. JACKSON, B. S., C. E., Prof. of Electrical Engineering in the University of Wisconsin, and District Engineer of the Edison General Electric Co. in Chicago, has opened an office for practice as a Consulting Engineer in the Rialto Building, Chicago. Mr. JACKSON was an assistant in the Electrical Laboratory at Cornell University.

Prof. W. S. CHAPLIN, Professor of Engineering at Harvard University and Dean of the Lawrence Scientific School, has been elected Chancellor of Washington University at St. Louis. Prof. CHAPLIN is 43 years old, a native of Maine, and a graduate of West Point. In January, 1877, he was appointed Professor of Civil Engineering in the Imperial University of Japan, at Tokio, remaining until July, 1882. While occupying this position he was called to take charge under the Minister of Public Works of the roads, railways, canals, docks, harbors and other engineering works of the empire. He resigned his position in Japan in 1882, receiving the imperial order of "Meiji" of Japan in recognition of his distinguished services. On his arrival in this country Prof. CHAPLIN became engineer of construction for the New York & New England Railway, then constructing its double tracks from Franklin, Mass., to Hartford, Conn. In September, 1883, he accepted the appointment of Professor of Mathematics in Maine College, from which place he was appointed in July, 1885, Professor of Engineering in Harvard University. Some time ago a gift of $100,000 was made to the Washington University by an unknown person, to be held in trust by three prominent citizens until a Chancellor should be selected. The selection of Prof. CHAPLIN releases the gift.

NEW PUBLICATIONS.

—*September Magazines.*—The *Popular Science Monthly* is replete with articles of absorbing interest this month. Those of greatest scientific importance are: JOHN FISKE'S "Doctrine of Evolution," "The Limits of State Duties," by HERBERT SPENCER, and "Can We Always Count Upon the Sun," by GARRETT P. SERVISS. In the last article the author gives a brief summary of present knowledge in regard to the sun, and concludes by saying that there is every reason to believe that, barring some ulterior cataclysm, astronomers may still be found studying the sun a million years hence. It would not be safe, however, to assume that five million years hence there will be any astronomers left on the earth.

Articles of more direct interest to engineers are: "A Classification of Mountain Ranges," by WARREN UPHAM, of the United States Geological Survey; "Glass Making," by Prof. C. H. HENDERSON, of the Philadelphia School of Manual Training; and "Views of Running Water," by M. J. PICCARD. Mr. UPHAM classes mountain ranges as folded, arched, domed, tilted, erupted and eroded. The Appalachian is the best type of the folded range, although examples abound. Almost the only example of the arched type is the Uinta range of northeastern Utah, while the domed type is exemplified in the Henry mountains of southern Utah. The tilted range is a common type, the Sierra Nevada and Wasatch mountains belonging to this class, while the close neighbor of the former, the Cascade range, belongs to the erupted class. The sixth class, eroded mountains, includes those which have been formed by the gradual erosion of the plains around them, accompanied by slow continual rising. It will probably surprise many to learn that the author believes the earth's surface to be at the present time "more varied, beautiful and grand through the existence of lofty mountain ranges than has been in its average condition during the previous long geologic ages."

The paper in the *North American Review* which claims most attention is "Plea for Railway Consolidation" by COLLIS P. HUNTINGTON, president of the Southern Pacific R. R. As is pretty well known, this noted financier is in favor of actual consolidation of all the railways of the country into a single system, or at most two or three. He gives strong arguments to prove that such a change would benefit both the owners of the roads and the public at large; but as in the latter part of his article, he makes an attack on present methods of Government control, it is hardly to be supposed that he would consent to the enlargement of Government control which is sure to be demanded as consolidation proceeds further.

Mr. HUNTINGTON makes a very good plea for the principle of charging in proportion to what the traffic will bear as the true principle of fixing rates; and bases a large part of his argument on the theory that the State and Interstate Railway Commissions do not recognize this rule. The fact is, however, that while legislators have often opposed it through ignorance, the railway commissions as soon as they were brought into contract with actual rate-making have been forced to recognize that "what the traffic will bear" is the most important factor in rate-making. This is the only article in the number which can be considered of special interest to engineers; but those of our readers who have served in the navy will be interested in reading Admiral PORTER'S account of the feat of Lieutenant CUSHING in blowing up the Confederate ram *Albemarle*.

The *Forum* has a symposium on "Present Problems in Education," one of the contributors to which is Prof. H. W. TYLER, of the Massachusetts Institute of Technology. His paper on "Technological Education in the United States" is chiefly historical, but he makes a strong argument for the technological education, as compared with the older systems of study, and shows how largely our future industrial development depends on the work of the technical schools. Dr. DAVIS S. JORDAN, President of the new Leland Stanford University at Palo Alto, Cal., which is to open its doors to students this fall, tells of the ideals which the founders of the institution propose to attempt to realize. From other sources we know that great emphasis is to be laid on the scientific and technical work in the new institution. Some of the reforms which Dr. JORDAN proposes to effect will be a welcome innovation to the best class of students. Mr. FRANK J. SPRAGUE'S article on "The Future of the Electric Railway" takes fully as optimistic view of the future of electric traction as the facts will warrant. Mr. SPRAGUE thinks that all city passenger traffic, both in the streets and on elevated and underground railways, will be carried on by electricity, and that suburban traffic can be handled better than with locomotives. As an example of his method of reasoning on this point he compares single cars run by electricity at 20-minute intervals with four car trains drawn by locomotives, and run every 80 minutes. As a matter of fact, in the morning and evening hours 8 car trains every 20 minutes are not by any means infrequent in suburban traffic. When Mr. SPRAGUE has figured the cost of an electric plant to handle such a traffic over a 20-mile road, he may change his mind as to the superiority of electricity over steam in the rush hours which make the handling of suburban traffic difficult. As he says himself, "The operation from a fixed station, of large units over long distance, at irregular and long intervals, is not feasible." But large units (long trains) must be run at irregular and long intervals in ordinary railway service, and Mr. SPRAGUE must be taken as admitting, therefore, that electricity is not suited to this work.

One other paper which deserves mention here, more because of its author than its subject, is "The Farmer's Isolation and the Remedy," by JOHN W. BOOKWALTER,

the well known Ohio manufacturer. He writes in a most entertaining way of the farm village as a cure for the farmer's discontent.

Harper's this month has very little that can be classed as technical. MONTGOMERY SCHUYLER continues his criticism of Chicago architecture and finds more to admire in the residential architecture than in the "business blocks" or the public buildings. Any engineer who may be thinking of trying his fortunes in China will do well to read FREDERICK BOYLE'S description of Chinese secret societies. If all he reports is true, the "T'ien-Ti-Hwey," which is the name of the most influential of these societies, is an organization beside which Thugs, Mollie Maguires and White Caps seem innocent and angelic. The members of this diabolic organization are numbered by millions.

Scribner's has for the fifth article of its series on Ocean Steamships a paper by Lieut. RIDGLEY HUNT, U.S.A., on "Steamship Lines of the World." The subject is discussed in rather a guide-bookish way, but some interesting facts are brought out. One is that a person may make the circuit of the world in a single steamer, one of a line making regular trips from Plymouth, England, to Cape Town, Africa; thence to Hobart, Australia; Wellington, New Zealand; Rio, Brazil, and thence back to Plymouth. The fare for this round-the-world voyage is only $650, for which the traveller has a journey of 25,150 miles, occupying about 81 days. Most people who go around the world, however, prefer to see something besides the ocean on their way. Those who take the usual route from New York to some European port, thence through the Mediterranean and Suez Canal to ports of India, thence through the East Indies and along the shores of China and Japan, and thence straight across the Pacific and from San Francisco to New York by rail, can make the trip in three months and $2,000 will be ample to pay their bills.

The Century this month has a paper by Hon. SETH LOW, President of Columbia College, on "The Government of Cities in the United States," which every engineer interested in municipal affairs ought not only to read but to study. By his experience as Mayor of Brooklyn, and by his ability as a lawyer, scholar, and enlightened thinker on economic questions, Mr. Low is entitled to speak with authority on this important subject. He advocates home rule, centralization of authority in the hands of the principal executive officers, and above all civil service reform as the most important reforms needed. One most interesting point which he makes is that city franchises ought never to be given away, but should be sold at auction for a period not longer than 20 years. Whether a city should make its own gas or build and operate its own street railroads, are questions that he does not attempt to discuss; but he says that "these are altogether questions of expediency. The city is certainly fortunate which is competent to do things of this sort for itself; but few American cities have manifested so great competency in other directions as to justify a very strong inference that they would administer successfully business of this kind."

Another article of far less importance, but which will doubtless find a greater number of interested readers, is on "The Possibility of Mechanical Flight," by S. P. LANGLEY, Secretary of the Smithsonian Institution. The author is considerably infected with the present popular craze on the subject of aerial navigation, which seems to have taken the place of the aluminum fever that was so prevalent a year or more ago. Some of the author's experiments on air resistance are certainly important if they were correctly carried out. He seems to be working along similar lines to those followed by the English inventor MAXIM, whose experiments with moving planes we described some months ago.

—*The Steam Engine*—A Manual of—for Engineers and Technical Schools, advanced courses. Part I., Structure and Theory. By ROBERT H. THURSTON, A. M., LL. D., Dr. Eng'g, Director of Sibley College, Cornell University, etc. JOHN WILEY & SONS, publishers, New York, 1891. Large 8vo. 871 pp., many illustrations and tables. Price, $7.50.

This volume, which is to be followed by another treating of general design and details, is not intended for beginners, but for educated, practical engineers and for students in advanced technical schools. The author, out of his wide experience as a practical engineer, investigator and teacher, has made a new departure here in developing a theory of application for the real, not the ideal engine. He uses the equations of thermodynamics of Clausius, which are simple, logical and exact, and combines with these the more satisfactory processes of application of Rankine. This combination, the author believes, is more satisfactory than either alone. The aim of Prof. THURSTON throughout is to combine the long established thermodynamic theory of the heat-engine with the wastes in practical use, or the losses of heat and energy, and thus to establish the complete theory of the machine, its operation and its efficiency. In a word, the skillful investigators of this day, with their broad experience and more exact methods, are elaborating what was once only theoretical and ideal in the engine into the advanced practice of the real engine itself, with all its conflicting elements that once defied pure theory. And while this has been the tendency of modern practice, Prof. Thurston, for the first time, attempts to give some consistency and unity to the theory of the real engine. We cannot attempt to go into the methods of the author, in the short space of a review, for these must be taken in their entirety to be of value. But we give the chapter heads as showing the general scope of the present volume. These are: The history, structure and philosophy of the steam engine; thermodynamics of gases and vapors; theory of the steam engine; compounding, jacketing, superheating and efficiency.

—*Scamping Tricks and Odd Knowledge Occasionally Practiced Upon Public Works.* Chronicled from the Confessions of some Old Practitioners. JOHN NEWMAN, Assoc. M. Inst. C. E. Author of "Earthwork Slips and Subsidences upon Public Works," "Notes on Concrete and Works in Concrete," "Iron Cylinder Piers," and "Queer Scenes of Railway Life." E. & F. N. Spon, London and New York. 1891. Cloth, 8vo., pp. 129. Price, $1.

This readable and interesting book is arranged as a conversation between two old sub-contractors, in the course of which they deliver themselves of numerous yarns relating to methods practiced on various kinds of work to deceive the engineers and obtain the much desired "extras," thus indicating some of the points to be especially looked after in superintending the construction of works, as well as the necessity of a very rigorous personal inspection by the engineer, without too much reliance on the paid inspectors. A still more interesting and valuable feature of the book, however, is that it is full of practical hints and notes upon differents methods of carrying out different kinds of work under varying circumstances, giving also advice as to the merits of the different methods. Incidentally the advantages of the Abt rack rail system for feeder and connecting lines, owing to its applicability to combined adhesion and rack rail lines, are referred to. A specimen of the character of the practical information on on "Screw Piles," was given on p. 151 of our issue of Aug. 15. The book is well printed and of compact and convenient form. The titles of the chapters are as follows:

I. Introduction. II. Screw Piles—General Consideration—Manipulation for "Extra Profit." III. Screw Piles—Details. IV. Iron Piles—Arrangement—Driving—Sinking by Water Jet. V. Timber Piles—Pile Driving—General Consideration. VI. Timber Piles—Manipulation for "Extra" Profit. VII. Masonry Bridges. VIII. Tunnels IX. Cylinder Bridge Piers. X. Drain Pipes—Blasting and Powder Carriage. XI. Concrete—Puddle. XII. Brickwork—Tidal Warnings—Pipe Joints—Dredging. XIII. Permanent Way. XIV. "Extra" Measurements—Toad Stool contractors—Testimonials. XV. Men and Wages—"Sub" from the Wood—A Sub-Contractor's Scout and Free Traveler.

—*Handy List of Books on Mines and Mining Assaying, Metallurgy, Analytical Chemistry, Mineralogy, Geology, Paleontology.* Compiled by H. E. HAFERKORN. H. E. Haferkorn, Milwaukee, Wis. Paper, 8vo., pp. 87.

This pamphlet is the fourth part of a general list of technical books printed in English from 1880 to 1891, including some published previous to 1880, which are still in the market. While the value of such a compilation can only be determined by actual use, the present catalogue seems to be well arranged and complete. A valuable feature is the summary of the contents of the most important volumes and extracts from criticisms of them by reliable authorities.

—*Report of the Special Agent in Charge of the Artesian and Underflow Investigations, and of the Inquiry for 1890.* By RICHARD J. HINTON. Pamph., pp. 17, and large map.

This report is from that of the Secretary of Agriculture for 1890. The whole subject has been treated with far greater fullness in the reports of Mr. HINTON and associates and that of Mr. NETTLETON, reviewed in our issues of Feb. 14 and July 11, respectively. The first report was abstracted at length in our issue of Feb. 21, *et seq.*

TRADE PUBLICATIONS.

—*Link-Belt Engineering Co.*, Philadelphia, Pa. Revised full list, Aug. 1, 1891. Paper, 4¾ × 5¾ ins.; pp. 24.

This pamphlet contains illustrations and price list of link belting of different kinds, elevator buckets, carriers, wheels, etc.

—*The Royal Clay Manufacturing Co.*, Uhrichsville, Ohio, 1891. 9 × 12 ins., pp. 63, many tables and cuts.

The number of things which are made from clay nowadays is a surprise to those who are not familiar with the rapid progress of the brickmaker's art. Both engineers and architects will be interested in looking over this catalogue. Engineers interested in paving are invited to send for a sample of a new paving brick made by this company. In the back part of the book are some useful tables and rules, the most important being the rules for masonry measurement adopted by the Chicago Masons' and Builders' Association.

—*Hydraulic Working and Interlocking of Railway Points and Signals*,—Supplement to the fourth edition of the catalogue of railway safety appliances. Saxby & Farmer, engineers and signal contractors, Kilburn, London, England. Paper, 12 × 19 ins., pp. 25, illustrated 1891.

This supplement is devoted to a description of the Bianchi and Servettaz system of hydraulic operation of switches and signals, with illustrations of plant actually in service. It is stated that the hydraulic working has not in general been considered sufficiently reliable, fears having been entertained that through leakage or some other cause the fluid pressure might fail to move the switch rails completely in either direction. This objection is obviated in this system by means of a return pipe which is provided for a return pressure from the switch to the lever in the signal cabin, constituting an infallible detector. One advantage of this system is that the switches may be conveniently and safely worked at extreme distances and with great ease. For this reason it is claimed to be particularly applicable in India and other countries where the native switchmen are unreliable, as the small interlocking levers can be placed in the station-master's office and worked by the station master without trouble. The catalogue gives a list of 37 stations, mainly in Italy, where the Bianchi and Servettaz system is in use, the number of levers ranging from 5 to 75.

SOCIETY PROCEEDINGS.

International Congress of Hygiene and Demography.

[FROM OUR LONDON CORRESPONDENT.]

(*Continued from page* 189.)

Dr. Hime spoke generally on the subject of sewer-air, in which he maintained no microbes or organisms had ever been found. Houses however should be disconnected absolutely from the sewers. Mr. Stephem Hoiman did not believe that in cold temperatures pipes up buildings would ventilate sewers. The best means of dealing with the sewer-gas was to pass it through an atmospheric gas-burner. Mr. H. Alfred Roechling held, like Dr. Hime, that sewer-air was not noxious, in fact he seemed to think it was healthy rather than otherwise, but sewers should have such falls that they were self cleansing. Mr. Baldwin Latham said he would not approve of the passage of large quantities of air through sewers. Professor Meijer has come again to the front with another contradiction and expressed a strong opinion that sewer-gas was very harmful. The reason microbes had not been found it it, was that the means of tracing them were defective. In the course of a brief reply, Mr. Santo Crimp stated that sewer ventilation and health had but a small connection, and Mr. Read gave some further arguments in favor of fixing sewer ventilators up houses.

"Water Supply" was the title of the first paper read on Wednesday, Aug. 12, the author being Mr. Alexander R. BINNIE, M. Inst. C. E., Engineer in Chief of the London County Council. He said that we might be confident of two facts, first, that water subject to pollution was a very potent factor in the spread of diseases; and secondly, that there was perhaps no better mode of introducing into the human system any substance which it could absorb, than by drinking it in the form of a solution. This being the case it almost followed as a natural consequence that the utmost care should be taken to guard our supplies of drinking water from contamination. Wells were frequent sources of death and disease due to the contamination by house drains, as had been shown in the cholera outbreaks of 1849, 1854 and 1866, which caused the death of over 16,000 persons. Chemical science in many cases was of little assistance, as it was powerless to detect the germs of disease It could tell them of the presence of organic matter, but without a careful inquiry into the previous life history of the water it could not pronounce that under all the circumstances it was a pure and safe drinking water. Land filtrationcould not be depended upon as an effectual preventative of disease. The precipitation and clarification of sewage effluents by chemical agency, also, could hardly be relied on, as it merely abstracted about one-fifth of the more solid impurity. What then were they to expect from the continuance of supplies to large cities from polluted sources, but that such cities might go on for years, perhaps, boasting of the chemical purity of their water, and the low death rate, forgetting that the constitutions of their water consumers were being gradually prepared to receive the germs of some great epidemic.

M. Bechmann, Ingénieur en Chef des Ponts et Chaussées de France, followed with a paper on "The Distribution of Two Waters of Different Qualities by Distinct Systems of Pipes." The author went into the question as to whether the system of double distribution, such as had been employed in Paris since 1854, should be universally adopted, and whether it was desirable from a hygienic point of view. His conclusions were that the ideal water supply of a town consisted in the uniform distribution of potable water suitable for all purposes, and that should particular exigencies necessitate the expedient of a double service, supplying two waters of different qualities, only one of these being potable, the double service should not be introduced into private houses, where potable water only should be at the command of the consumer.

The same subject was dealt with by Mr. W. Matthews

under the title of "separate water supplies for domestic and sanitary purposes." He described the system in use at Southampton, England, where there was a domestic supply of great purity but somewhat hard. To remove this hardness a softening process had been adopted with great success. For many years prior to 1888 the water collected from the drainage of the Common 160 ft. above the town, was suffered to run to waste, but upon new works being initiated the author drew up a scheme whereby this water could be used for sanitary purposes, and a saving be effected in the consumption of that from the new works, which had to be pumped and softened at considerable cost. A line of pipes was already in existence leading from two old reservoirs. These pipes were put into order and utilized as the main supply for sanitary purposes. This water was used exclusively for public purposes, such as road watering, sewer-flushing, for urinals and the like no connections being made with houses under any circumstances. In very dry weather it had been found that the drainage from the Common was insufficient for the sanitary supply, and to meet any unusual demand an auxiliary supply had been established which is pumped from wells on the Common, by hydraulic engines. Secondary supplies had been adopted in but few towns in Great Britain, and then chiefly in connection with sea-water supply; but Mr. Matthews was of opinion that in many places there existed supplies which although unfit for domestic purposes, might be obtained by gravity at little cost, and by the judicious use of existing mains distributed as a supply for sanitary purposes at a trifling expense. One great benefit which arose from the presence of a separate and cheap supply was that there was less tendency to be sparing in the use of water for sanitary purposes, whereas when the water used for these purposes had to be pumped and distributed at considerable cost, the great object of the authorities was to reduce the consumption to a minimum.

Mr. Maignen considered that it was a mistaken impression to think that one must have a supply either of naturally good water or else have bad. Bad water could be purified and rendered good. Prof. H. Robinson said that a constant water supply should be compulsory, an intermittent supply being injurious to health. Where an intermittent supply existed, consumers should not use any water without thoroughly filtering it. As regarded a dual supply of water, there were many difficulties in the way of the adoption of the system for large towns. Treating the same point, Dr. Franklin thought it would be advantageous if the double supply could be introduced into houses, but in that case there should be left no possibility of the worse quality being accessible for drinking purposes. Referring to earlier papers which had been read, he stated that infection was not carried by sewers unless the sewers were very badly constructed. Sewer gas was freer from organisms than ordinary air. Organisms would pass through sand filters, and one could not rely on bacteriology to determine with precision whether water was infected or not. Specialists had failed to detect typhoid germs in water which was known to contain them. There was no certain method of purifying water except by boiling; but of course this was impracticable for the water supply of a town. Mr. Baldwin Latham mentioned that Continental experiments as to the purifying properties possessed by rivers had shown that the action of light was an important factor in the matter. Dr. Odlen said that under suitable conditions the oxidizing power of rivers was enormous. As regarded microbes, he believed that the animal body had power to destroy a large number, and that they would only cause harm when consumed in large quantities. For his own part, he would not object at all to swallow one microbe per diem. Mr. Binnie, with reference to the dual supply question, believed that the system demanded further investigation before being introduced into large towns.

Dr. L. Csatáry de Csatár presented a paper on the subject of Railway Hygiene, in which he gave the following conclusions: that the construction of buildings, stations and carriages should conform to hygienic rules; that carriages with lateral passage ways were a source of danger in the case of accident; that special carriages should be provided for transporting the sick and wounded, and that stations and trains should be furnished with the means of rendering assistance to injured persons; that railway employées should not be overworked; and that the sanitary service should be in charge of a chief medical officer and medical men should be appointed to attend upon the railway staff and on passengers.

The next paper was by Dr. W. Anderson, F. R. S., M. Inst. C. E. on "The Renovating Purifier for rendering River Water suitable for Potable Purposes. The apparatus in question has now been at work for six or seven years. It consists of a cylinder supported horizontally on two hollow trunnions of which one serves for the entrance and the other for the exit of the water. The cylinder contains a certain quantity of metallic iron, either in the form of cast iron borings or preferably of scrap iron, such as punchings from boiler plates. The cylinder is kept in continuous but slow rotation, the iron being constantly lifted up and showered down through the passing water by a series of shelves or scoops fixed inside the shell of the cylinder. By this means, the water as it flows through, is brought thoroughly into contact with the charge of iron while in addition, by its constant motion and rubbing against itself and the sides of the cylinder, it is kept always clean and active. The water as it leaves the cylinder appears to have undergone only one change of importance namely, a quantity of iron ranging from one-tenth to one-fifth of a grain to the gallon has been taken up, and to get rid of this the water has to be aerated either by blowing in air, or by merely allowing it to flow along a shallow open trough. In both cases repose in a settling reservoir is necessary. After from two to six hours the greater part of the iron will have subsided to the bottom of the settling tank, usually as loose flakes of iron peroxide associated with organic matter and other impurities, and the water is then ready for filtration. In most cases a rapid passage through a shallow layer of sand is all that is required to separate the iron, which remains as a fine layer on the surface of the sand, while the water issues from the filter free from iron, greatly ameliorated as regards organic matter and practically deprived of microbes. Details were given of the results of experiments arrived at at Boulogne-Sur-Seine with the purifier, when bacteria were reduced to less than 50 per cubic centimetre. In consequence of these trials larger apparatus is being constructed for permanently dealing with the whole of the supply at these water-works.

"Influence of Ground Water Upon Health." This was the subject of a paper by Mr. Baldwin Latham, in which it was stated that in historic periods when particular epidemics had been rife, they had mostly occurred in times of drought when the ground water was exceptionally low. There was every reason to believe that the ground water itself, except when polluted, had no influence as a cause of disease, but was merely the measure or indicator of the influences which were at work within a polluted soil and of certain organic changes which took place within the recesses of the soil and which led to the development of the conditions favorable to a certain class of disease. The actual drying of the ground was a condition favorable to the general good health of the country, and this circumstance marked in the general death rate the potential influence of certain diseases, so that the general health of a district appeared to be good while at the time it might suffer intensely from a certain class of disease, of which low ground water was the indicator. When, however, the conditions became extremely intense and the ground water exceptionally low, the influences at work affected the death rate as a whole. On the other hand, in periods of excessive rain, with high ground water, the conditions were usually favorable to health and in all places where the ground waters were of a uniform level, such as seaside places, which were governed by the mean tide level, and river valleys, with porous soils, are usually healthy.

Mr. R. F. Grantham read a paper on "Drainage and Irrigation of Lands in their Relation to Health." He considered that all lands could be made salubrious by the agency of drainage in one form or another, and pointed out that while the subject of town drainage had been much discussed of late years, less attention had been given to the drainage and irrigation of land in their relation to the health of the inhabitants in the country.

Undrained lands in the valleys of rivers, and lands subjected to floods, gave rise to ague, rheumatism and neuralgia. The drainage of marsh lands, the removal of obstructions and engineering improvements of the water channels would obliterate countless evils. Irrigation had conferred immense benefits upon India, but the works had produced serious insanitary conditions.

As a remedy for these a system of subsoil drainage had been recommended where lands are over-saturated.

Dr. T. Thornton considered that sub-soil drainage should go hand-in-hand with the extension of irrigation in India. If water were sold there by meter it would prevent the over-saturation which caused ill health. General McLagan, R. E., also bore evidence that the high level Indian irrigation canals were the cause of illness. In this connection it may be mentioned that a special Indian meeting was held during the Congress under the chairmanship of the Right Honorable Sir Mountstuart Elphinstone Grant Duff, G. C. S. I., C. I. E., late Governor of Madras. The papers read, however, were mainly of local interest only.

(TO BE CONTINUED.)

New England Water-Works Association.—The annual fall excursion will take place Sept. 18 to 21, and will be a trip of members and friends to Center Harbor, N. H. For particulars address Mr. R. C. P. Coggeshall, secretary, New Bedford, Mass.

New England Railroad Club.—An excursion to Crescent Park, R. I., and steamboat ride on Narragansett Bay will take place on Wednesday, Sept. 9. A special train will leave Park Square Station of the Old Colony R. R., at 9 A. M., and will leave Crescent Park at 5 P. M. for the return trip. Tickets can be had of the secretary at $2 each, covering the entire expense.

FRANCIS M. CURTIS, Secretary.

Roadmasters' Association of America.—At the Ninth Annual Convention, to be held at the West Hotel, Minneapolis, Minn., Sept. 8-10, the following questions will be discussed: Standard Frogs, New Joints, Interlocking Devices (Position of Guard Rail at Derailing Switch), Track Jacks, Track Work (Best method with various kinds of ballast), Steel Rails (proper weight, section and chemical composition), Laying Rails (even vs. broken joints). Reduced rates have been secured at the West Hotel.

American Society of Civil Engineers.—The first meeting of the season was held Sept. 2, Mr. T. C. Clarke in the chair. A paper by Mr. E. L. Ransome on "Concrete Beams Reinforced by Twisted Iron for Floor Construction," was read by the Secretary. The system referred to consisted in imbedding twisted bars of iron in the concrete beams, by which it was claimed a very strong floor can be made at small cost. The California Academy of Sciences, San Francisco, has 5 floors of the museum portion, or about 50,000 sq. ft., so constructed, and estimated to carry with safety 250 lbs. per sq. ft. The museum building of the Stanford University at Palo Alto, Cal., is being constructed as a monolithic structure, the foundation, walls, 2 floors and roof being of concrete and twisted iron. The building is 300 × 50 ft., with spans of 45 ft. and less. The depth of beams ranges from 7 to 45 ins., with floors 3 ins. thick. The concrete is of hard trap rock and Portland cement, in the proportions of 1 to 14 for walls and 1 to 6 for floors.

The paper gave rise to considerable discussion, evincing a sceptical feeling as to the advantages claimed. Mr. Seaman thought the twisting would be an injury rather than a gain, and that in case of fire the iron would stretch, and owing to the difference of expansion of the concrete and iron the effect of the latter would be lost. Mr. Lindsay, a visitor, described a system of concrete floor construction in which a network of wires 1½ ins. apart was hung from the top of the beams, and a flat floor of concrete made, extending a little above the beams and below the bottom of the curve of the wires, the thickness being about 4 ins. for a span of 6 ft. 3 ins. The wires are No. 12 gage, and those from beam to beam are double. A thin flat concrete ceiling protects the lower part of the beams, and the beams are also coated with the concrete mixture. This construction can be built by unskilled labor. Mr. Fouqué thought the use of sawdust in concrete or plaster for fireproofing material to be a mistake, experience on the West Shore R. R. having shown that it is completely destroyed by fire. Gage mortar on wire lath gives very satisfactory results, but is expensive.

A paper by Mr. E. E. Russell Tratman, on "Longitudinals vs. Cross Ties for Railway Tracks," was then read by the author. This paper, in condensed form, was presented at the annual convention in May, as a discussion upon Mr. T. C. Clarke's paper on "The Advantages of a Longitudinal Bearing System for Railway Tracks" (ENGINEERING NEWS, May 30, 1891). Beginning with the consideration of timber longitudinals, it was stated that while this system of track is still in use on some parts of the Great Western Ry., England, it is no longer the standard track of that road, all new track being laid with cross ties. Longitudinal timbers are, however, extensively used across railway bridges in England, Europe and the British colonies, sometimes with double-headed rails in chairs, and sometimes with flange rails secured by bolts or screw spikes. The Victoria Bridge of the Grand Trunk Ry., across the St. Lawrence River at Montreal, has a single track of flange or tee rails on longitudinal timbers. In regard to metal longitudinals, it was stated that while at one time favorably considered in Germany and Austria, and still in use to some extent, this system has not been found satisfactory in general under heavy traffic, and in several cases it has been abandoned. Among the principal defects in the longitudinal system are the lack of latteral stiffness, the limited area of bearing on the ballast as compared with that of the crosstie system, the difficulty of mantaining the track in line and surface, the difficulty of insuring proper drainage, and the complications at curves, frogs and switches. Mr. Tratman considered the general introduction of the longitudinal system very improbable, and that more attention should be paid to the improvement of the cross tie system in the way of heavier rails, more efficient rail fastenings and rail joints, improved switches and frogs, preserved wood ties, metal tie plates and steel ties; also in more attention to maintenance.

Owing to the lateness of the hour discussion on this paper was postponed, but Mr. Clarke read a letter from Mr. Hohenegger, of Austria, in regard to the latter's system of iron longitudinal track as referred to in Mr. Clarke's paper.

The following candidates were declared elected:

Members: Arthur Beardsley, Swathmore, Pa.; L. De Coppet Berg, New York, N.Y.; Frank E. Bissell, Denver, Col.; Carl A. C. Both, Portland, Me.; Frederic Danforth, Gardiner, Me.; J. A. Fairleigh, Chattanooga, Tenn.; C. C. King, West New Brighton, N. Y.; Wm. Watson, Boston, Mass.

Associate Members: A. C. Cunningham, Pittsburg, Pa.; F. Freyhold, Washington, D. C.; M. L. Gardner, Jersey City, N. J.; W. S. Humphrey, Sedalia, Mo.; Geo. H. Hutchinson, Pittsburg, Pa.; R. C. McCalla, Tuscaloosa, Ala.; J. E. Ostrander, Albany, N. Y.; E. A. Werner, Chicago, Ill.

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AND

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Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

American Society of Swedish Engineers.—Sept. 3. At 250 Union St., Brooklyn, and 347 North 9th St., Philadelphia.
Northwest Railroad Club.—Sept. 5. Rooms, Union Station, St. Paul.
Civil Engineers' Society of St. Paul.—Sept. 7. Secy., C. L. Annan.
Engineers' Club of Kansas City.—Sept. 7. Rooms, Baird Building. Secy., H. Goldmark.
National Electric Light Association.—Annual Convention Sept. 7-12, Montreal, Que. Secy., J. W. Beane.
Atlanta Society of Civil Engineers.—Sept. 8. Secy., Parker N. Black, Room 39, Capitol Block.
Denver Society of Civil Engineers.—Sept. 8. "Municipal Engineering." Secy., Geo. H. Angell.
Northwestern Society of Engineers.—Sept. 8. Rooms, Occidental Block, Seattle. Secy., E. H. Warner.
American Roadmasters' Association.—Annual Convention, Minneapolis, Sept. 8, 9. Secy., J. P. Ramsey, Muncie, Ind.
Civil Engineers' Association of Kansas.—Sept. 9. Secy., J. C. Herring, Wichita, Kan.
Master Car and Locomotive Painters' Association.—Annual Convention, Sept. 9, Washington, D. C. Secy., Robert McKeon, Kent, O.
New England Railroad Club.—Sept. 9. Rooms, United States Hotel, Boston.
Civil Engineers' Club of Cleveland.—Sept. 11. Secy., A. H. Porter, 50 Euclid Ave.
Northwestern Track and Bridge Association.—Sept. 11. Rooms, Union Station, St. Paul.
Western Railway Club.—Sept. 15. Rooms, Rookery Building, Chicago.
Engineers' Society of Western Pennsylvania.—Sept. 15. Secy., J. H. Harlow, Pittsburg, Pa.
American Society of Civil Engineers.—Sept. 16. Secy., Francis Collingwood, 127 East 23d St., New York.
Engineers' Club of St. Louis.—Sept. 16. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.
Engineers' Club of Cincinnati.—Sept. 17. Secy., J. F. Wilson.
New York Railroad Club.—Sept. 17. Rooms, Gilsey House.
Scandinavian Engineering Society of Chicago.—Sept. 17. Secy., T. G. Philfeldt. 113 Adams St.
Montana Society of Civil Engineers.—Sept. 19. Helena.
Engineers' Club of Minneapolis.—Oct. 1. Rooms, Public Library Bldg. Secy., F. W. Cappelen.
Association of Civil Engineers of Dallas.—Oct. 2. Secy., E. K. Smoot, 803 Commerce St.
Technical Society of the Pacific Coast.—Oct. 2. Secy., O. von Geldern, 819 Market St., San Francisco.
Western Society of Engineers.—Oct. 7. Secy., J. W. Weston, 280 La Salle St., Chicago.

THE International Congress of Hygiene and Demography, which has so lately concluded its labors in London, was a most notable gathering of men interested in a field of science that until very recent times had no existence. It is so new a congress that at the very outset the presiding officer felt himself called upon to explain to his audience the meaning of one of its titles, for the very word "demography" is newly coined and found only in the very latest of our dictionaries. It means that branch of anthropology which relates to vital and social statistics and their application to the comparative study of races and of nations. Our readers will have noticed in the reports of this congress, gathered by our own correspondent at the meetings, that the mass of the papers presented related to sanitation, as was but natural in view of the great importance of this field of investigation, an importance only now becoming fully recognized by authorities and communities. But the speakers included the ablest engineers, the best known scientists and the closest students of Europe in this particular branch of science, and their contributions have a correspondingly great value.

While we have received a full set of the printed papers and will publish the more important of these as time and space permits, that of Dr. FRANKLAND, printed in this issue, is somewhat startling in its departure from accepted theories, and it applies directly to the pending investigation into the pollution of our Croton water-shed. As the result of a series of observations covering a long period of years, Dr. FRANKLAND practically denies the theory of the self-purification of rivers in the course of their flow, at least so far as the destruction of their organic impurities is concerned. He admits that these disappear, to the eyes at least and even to the less delicate tests, but that the polluting matter is destroyed is quite as improbable, he says, as it is to suppose that when a bag full of feathers is shaken into the air, the feathers should be decomposed in their short flight through space. Past deductions in this direction have been based upon personal observation generally, and were made without the aid of the exact methods of the present day. In the light of his investigations Dr. FRANKLAND now believes that when these cases of self-purification are carefully studied, it is very doubtful whether the phenomenon is due to anything beyond dilution and sedimentation. In other words, the organic matter in solution will pass on to the point of consumption or discharge, with all its latent power for mischief undiminished by the length of the line of flow, or exposure to air and other agents that have previously been supposed to purify water. This is a serious matter for consideration and further research, and if the case be proven it would lead to the acceptance of Mr. KIRKWOOD'S famous advice regarding the treatment of polluted water—that the safest treatment is—to let it alone and go elsewhere for a source.

But while Dr. FRANKLAND says that there is no reliable evidence of any rapid oxidation of dissolved organic matter, as has been generally supposed, he finds that there is a marked removal of microbes by sedimentation during the flow of a river. This is a fact of great hygienic importance. But as other investigators show that many forms of microbes remain alive for a long time after being deposited on the bed or sides of a stream, or even in lakes like those in Switzerland, the natural question is, what happens to these in the case of a rise in the water sufficient to scour off and carry down this deposit. If dangerous organic matter is simply diluted and deposited, but not destroyed, it is evident that the advice of Mr. KIRKWOOD still holds good.

NOBODY questions the suitability of the electric current for lighting and power purposes, or for the production of heat where the quantity required is small and the intensity is great. For general heating purposes, however, as we have before pointed out, the electric current is at a great disadvantage compared with systems of heating now in common use. Notwithstanding this, inventors are busy devising electric heaters of all sorts and kinds, and the electrical journals take pains to spread the rumors of their reported successes. As a sample of this we find in the *Electrical World* of Aug. 15 a statement that the Burton electric heater is to be applied to the limited express trains of the Pennsylvania R. R. and to other Pullman cars. A very good answer to this story is a letter from the inventor of the Burton heater to this journal in our issue of Aug. 23, 1890, in which he said:

> Neither the Burton Company nor the inventor of the Burton heater make any claim that their heater can be applied to the warming of steam passenger cars, for the reason that, so far, no device has been perfected for producing the necessary current while the train is in motion. Neither do they claim that buildings could be economically warmed by them in cases where the usual profit is charged by electrical companies for the supplying of the electrical current at so much per electrical horse-power. . . . What the Burton heater claims to be is an electric heater for electric railway cars.

We may say further that General Manager PUGH, of the Pennsylvania R. R., has written us denying that that company has any idea of using electric heaters; and the Pullman Company would probably make a similar denial if they thought it worth while. If any of your readers believe in electric heating for railway cars in the present state of the art, we would refer them to an article in our issue of Aug. 9, 1890, in which it was shown that it would require an engine and dynamo of over 200 horse-power to furnish electricity enough to heat a passenger train of 7 cars.

THE error which is really at the bottom of the electric heating craze is that by some ingenious form of resistance coil dubbed an electric heater, it is possible to get out of a current of electricity more heat than that corresponding to its energy—the old perpetual motion error in a new form. A very good and economical way to experiment on this question of electric heating is to take an incandescent lamp, which, by the way, is practically just as efficient an electric heater as any inventor has yet devised. A small portion of the energy imparted by the current is converted into light, it is true, but this is converted into heat when it strikes an absorbing surface; so if the little bulb is shut up in an oven or some place where its light does not escape, we may be sure that all the heating power there is in the current is being utilized. Even if the lamp is in a room, the light absorbed by the walls is converted into heat. It is one of the chief advantages of the electric light that rooms lit by it are so little heated as to be much more comfortable than rooms lit by gas. Let the enthusiasts on electric heating put incandescent lamps into a room on an ordinary winter day until the temperature is kept at 72°, and then compute the cost per day of the current necessary to supply the lamps.

Those who can comprehend the significance of figures, however, need waste no time in such experiments. A 110-volt incandescent lamp, using 1 ampère of current, uses about $^1/_7$ HP. of electrical energy, or about 282,860 ft. lbs. per hour. Dividing this by 772, the mechanical equivalent of heat, we obtain 366, as the number of heat units which an incandescent lamp will develop per hour. If the lamp were used for heating water, in an hour it would raise a little over a quart of water from 60° to the boiling point, if no heat were lost by radiation.

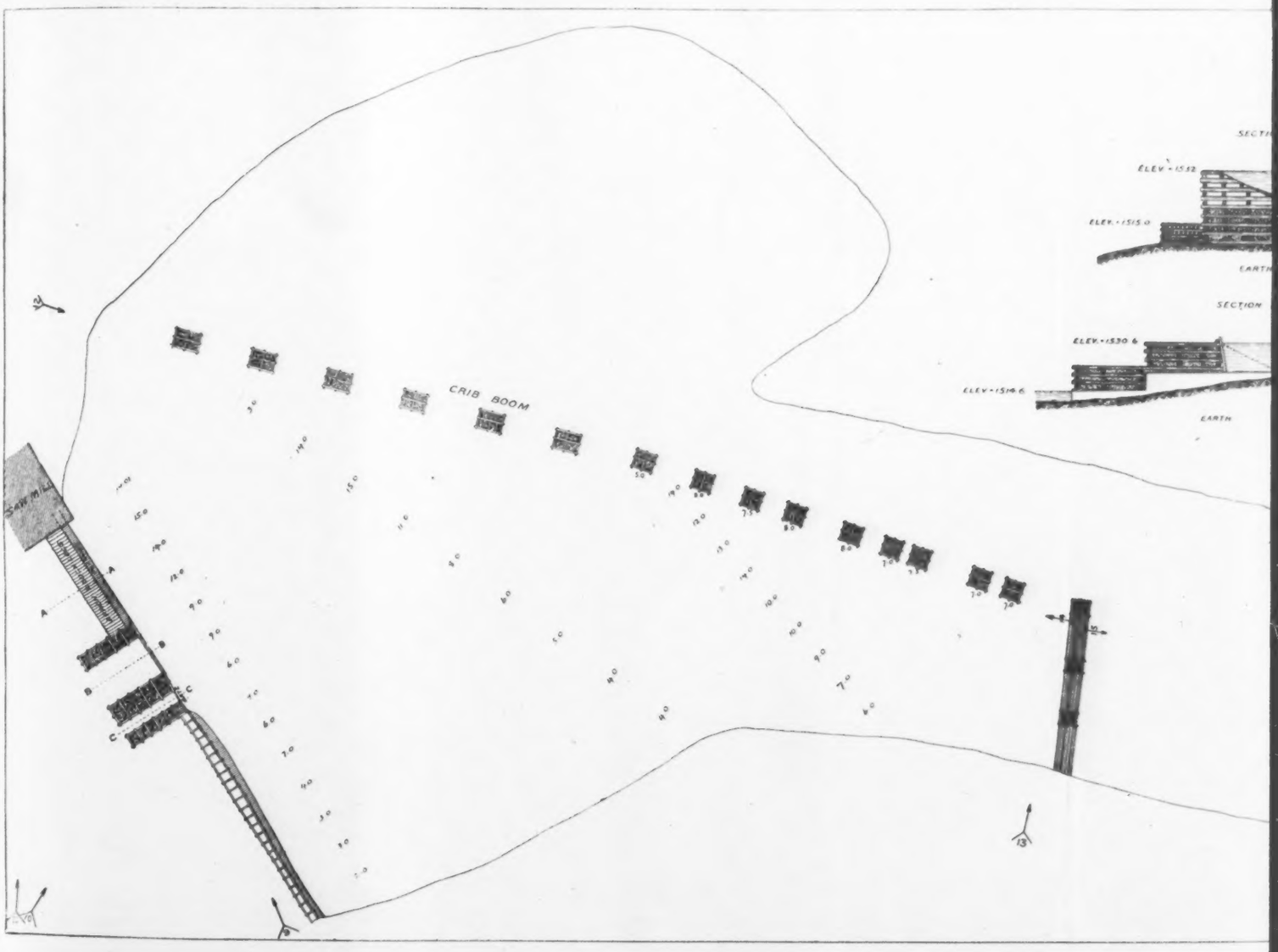
WE may arrive at a very accurate idea of the cost of electric heating by comparing it with the cost of gas used in gas stoves for domestic and other purposes. In the paper by Mr. GEORGE H. CHRISTIAN, published in our issue of May 30, fuel gas, at 50 cts. per 1,000 ft., was stated to furnish a given amount of heat at the same cost as hard coal at $7.50 per ton. But with the exception of the natural gas regions there are few cities where gas for heating purposes can be had at this rate. A common price, however, is $1 per 1,000 ft., and at this price it is generally considered a pretty expensive fuel, even for cooking purposes. The total calorific value per 1,000 ft. of gas may be taken as 400,000 heat units.

Let us see how many heat units can be obtained for a dollar if we use electricity for heating. The

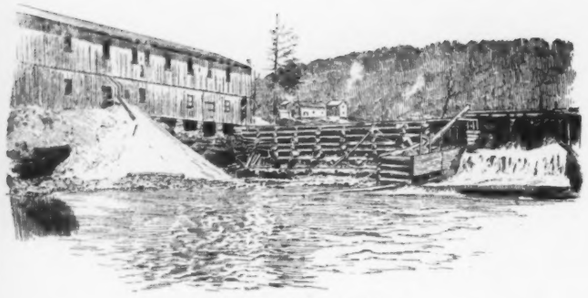
9. THE DAM, FROM SOUTH END.

10. THE DAM AND SLUICE, FROM BELOW

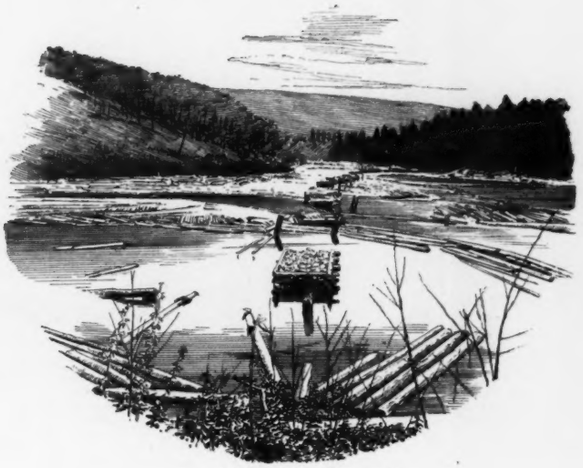
11. THE S



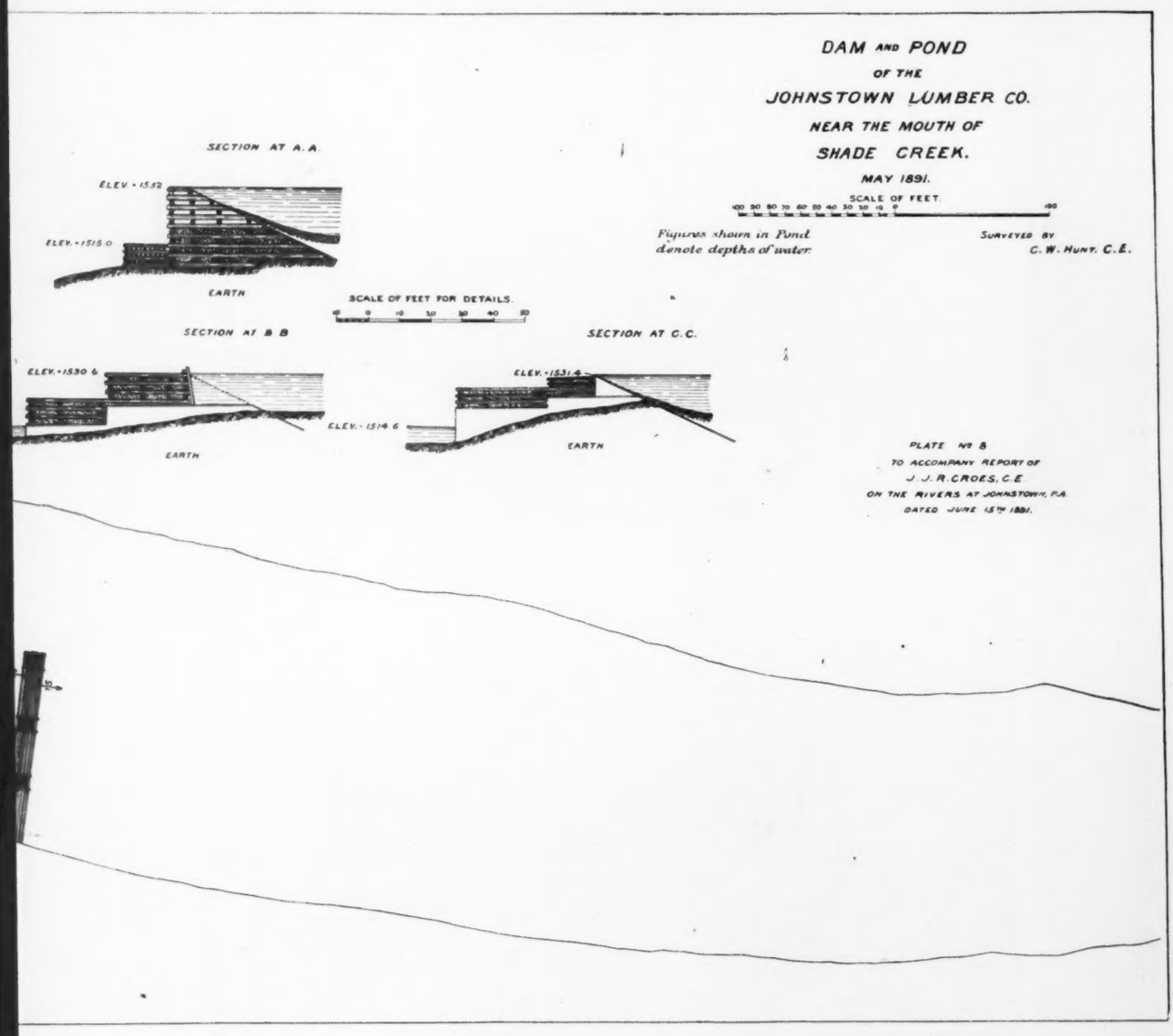
DAM AND POND OF THE JOHNSTOWN



11. THE SLUICE GATES AND SPILLWAY.



12. THE CRIB BOOM, FROM THE DAM.



F THE JOHNSTOWN LUMBER COMPANY, SHADE CREEK, PA.

13. THE CRIB BOOM, FROM SOUTH SHORE.

14. THE CRIB BOOM, LOOKING DOWN STREAM.

15. THE POOL AND LOGS ABOVE THE CRIB BOOM.

prices of electricity in New York City vary from 14 cts. per HP. hour for incandescent lighting to from 5 cts. to 10 cts. or more per hour for power purposes. Let us take the lowest price, 5 cts. per HP. hour. Then 1 HP. equals 33,000 ft. lbs. per minute, equals 1,980,000 ft. lbs. per hour. Dividing this quantity by 772 we have 2,565 as the heat units corresponding to 1 HP. hour of mechanical energy. Then if 2,565 heat units obtained from electric energy cost 5 cts., for a dollar we can obtain 20 times as much, or 51,300 heat units. But a dollar's worth of gas will furnish 400,000 heat units; hence the electric heating is nearly eight times as expensive as the heating by gas at $1 per thousand feet.

THIS is a period of rapid changes in all things pertaining to transit, especially on the railways of the country. Within a comparatively few years train-loads have been increased in about the proportion of one to three, and the average speed of trains is now about twice what it was a few years ago. The railways of our country are full of bridges and viaducts designed and built under an entirely different condition of practice; and yet they are in daily use under the heavier engines and loads and higher speeds. There are still enormous lengths of timber trestles on the lines of our railways, not only in the newer Western States but in the Atlantic States as well; and while no class of structure needs sharper looking after for security, this timberwork probably receives the least attention as a rule, of all the structures on the line. Accidents occur upon these out-of-date structures with entirely too great frequency, and will continue until they are either rebuilt or strengthened so as to even more than meet present requirements.

In this connection we do not consider it in the light of personal advertisement to call the attention of the general managers of roads which are without experienced engineering advisers as part of their permanent staff, and it is on such roads that these suspicious structures usually exist, that there is a class of experts called consulting engineers in this country. Every large centre of population now has one or more of these of undeniable experience and authority, men like COOPER, BOUSCAREN, CLARKE and BOLLER, whose business it is to inspect, pass judgment and furnish plans for new structures or repairs. Even when a road has its own Chief Engineer, his duties are usually so multitudinous that it is still economical, considered purely from a commercial standpoint, to engage the services of an expert in periodical inspections. Aside from all considerations of loss of life and damage to reputation, one serious bridge accident usually entails more actual and material loss than the expert fees sufficient for many years' inspection combined with considerable general repair. It is often the neglected, cheap structure that causes all the trouble. Engineers of the class referred to are thoroughly experienced, practical men who must necessarily require a substantial return for their experience and knowledge far in excess of either the means or requirements of many railways in this country. But the fact that this experience can be secured by any one needing it, for a comparatively small consideration, makes it awkward for the corporation that has to explain the presence of weak and unsafe structures on its line, especially when these lead to fatal accidents.

The Modern Navy.

Among the exhibits of the Elswick Works, of Lord ARMSTRONG, at the Naval Exhibition in London, is a diagram that tells more than volumes of text of the wonderful advance made within about two decades in the manufacture of high power guns and the armor to resist their projectiles. This exhibit is a full sized drawing of the path of an 1,800-lb. shot fired from the 110-ton gun of H. M. S. *Sanspareil* on March 14, 1891. Commencing at the face, we have first 20 ins. of compound armor, backed by 8 ins. of an iron plate fastened to a heavy wrought iron frame; then came 20 ft. of solid oak timbers, 5 ft. of granite wall, 11 ft. of concrete, and, beyond all, 6 ft. of brickwork. The projectile that penetrated all this material and lodged in the center of the rear brick wall, shattering all the brick ahead of it, left the muzzle of the gun with a velocity of 2,079 ft. per second, due to a powder charge of 960 lbs. When we consider that this means a total energy of impact of over 55,000 ft. tons, the penetration is not so marvelous, but we can not help asking what NELSON and the naval heroes of his day, or even the commanders of battleships in our own late war, would have thought of a machine capable of developing this terrific power. The hulls of the strongest ships at Trafalgar would have presented no more resistance than walls of paper, and the ironclads of 1865, that changed the type of warships forever, would have been but little stronger in comparison

The battleship of this decade is a marvelous machine, and to construct and fight it requires the application of nearly every branch of modern science. It is as far in advance of the ships that NELSON led to victory in the beginning of this century as his ships were an improvement on the ark of NOAH. From the period of HENRY VIII. of England to a time almost within the memory of any man past middle life, the real advance in shipbuilding was practically confined to remodeling the hull and to improving the sailing gear, and until within a very recent period steam in warships was simply looked upon as an auxiliary to sails. Even as late as our last war some of the sailing sloops-of-war, like the old *Portsmouth*, could outstrip in a fair wind almost any of the steam men-of-war of the *Hartford*, *Brooklyn* or *Oneida* type. In the matter of armament the advance was even slower. In the beginning of the civil war smooth bore guns formed the batteries on our ships; and the 15-in. smooth bore, with its 500-lb. projectile and 80-lb. charge, that armed our later monitors, was a wonder to the old world. Of high power rifled guns, a 150-lb. Parrott was the best we could show at the close of the war, and this gun was handled aboard ship with a certain degree of caution and suspicion.

The change in warships and in their armament, within the last three decades, is almost more marked than in any other one department for purposes of war or peace. Wooden walls and ribs of oak have been replaced by frames of steel and solid armor 17 ins. thick; the sails have almost disappeared, and only military masts are now used on the heavier vessels, and in their place we have enormous engines developing thousands of horse-power, twin and triple screws and all the intricate and heavy machinery that accompanies them. For the heaviest guns of the older date we have marvelous machines that throw at one discharge almost a ton of steel, and put behind this projectile half its weight of a stronger powder than the generation passed ever dreamed of. Instead of the light charge and low velocity of their day we have imparted to the enormous bolts of modern times a velocity of 2,000 ft. or more per second and a resultant impact that is equivalent to 55,000 ft. tons at least under a full service charge. The late machine-gun of small calibre, that is yet efficient against men alone, is now supplemented by a rapidfire gun that is really easier to handle than an old fashioned musket, and can yet fire at least twelve wellaimed shots per minute with an effective range of over two miles, and penetrate ¾ in. of steel inclined at a low angle at a distance of over one mile. To handle and load the heavy guns employed hydraulic, pneumatic and electric power is utilized. Electric light and electric motors light the ship and supplement the labors of the crew; high explosives are used in torpedoes that are to be launched from the ship, and powerful searchlights seek out and locate the approaching foe; distance is measured and guns are ranged by ingenious electric appliances, and in a hundred other ways the warship of to-day is a child of our later scientific knowledge and an intricate but most intelligent machine.

While taking rank for many years as one of the feebler naval powers, the United States is at last waking up, and is busily creating a navy that, as far as it goes, is a credit to the resources, in brains and capital, of this prosperous nation. But we can take some lively satisfaction in the knowledge that events upon these shores, in 1861-65, set the whole world to rebuilding its navies, and providing heavier guns, and it is interesting to trace the influence of the United States in bringing out the changes referred to.

Iron-clads were not absolutely novel in 1861, for France had already put into practice some of the teachings of our own FULTON, dating from 1806. But the necessities of the Confederates, in our own war, caused them to create the floating battery with inclined sides and to substitute steam for sails. The Union forces devised similar floating forts for pounding batteries and forcing their way down the great rivers of the West; and in the *Monitor*, with its low free-board and revolving, heavily armored turret, ERICCSON gave birth to an absolutely new type of war-ship that is yet accepted in part among the best of modern designs. Torpedoes and torpedo boats are distinctly American, and date from the time of BUSHNELL, in 1776, and FULTON, in 1806. But it was in our civil war that their power and efficiency were first demonstrated in actual combat, and on an extensive scale. RODMAN, with his 11 in. and 15 in. smoothbores for monitor service, made the first wide departure in the weight of projectile that could be hurled from the deck of a ship; though the light powder charge and low velocity imparted to the shell makes his guns interesting only as a type and as a first step in a new order of things. Machine guns were American, and the maker of the best and universally used rapid fire gun is also a native of this country, though he was driven abroad with his inventions by the sudden slackening of interest in all things military, in this country, at the close of the war.

We can clearly claim then that it was our experience in an unhappy struggle of four long years, and the devices that were then put forth to meet the emergencies of a nation unprepared for war, that changed the methods and material of sea fighting throughout the world. But after the close of that war we abruptly halted in our naval advance and devoted ourselves to the arts of peace and to the obliteration of a colossal public debt. Our navy, from being the most numerous in ships and the most powerful in armor and armament, rusted, rotted and dwindled down until it became a national reproach, and was even laughed at by insignificant South American powers. But we had inaugurated a radical change in all things naval, and whether intended or not, we were wise in allowing other nations to pass through this transition period and pay for the blunders and experiments incidental to this new departure. Other nations paid dearly for their experience, in unstable, unseaworthy ships, in useless armor, in wrought iron guns, and in the many other features in which actual practice would alone teach what was good or bad in design and material. For many years every increase in thickness and quality of armor only brought into existence more powerful guns; steel was substituted for wrought iron in the gun and its projectile, new and more powerful powders were used to give greater and greater velocity and power to the shot, and the change in battle ships rendered old land defenses useless and new types had to devised for these. It was a seemingly never ending struggle between force and material, and the period lying between 1865

and 1885 covered a field of enormously costly experiments to all civilized nations save our own.

But about 1884 the United States was forced by the rotting hulls of its cruisers and the utter folly of rebuilding a navy on old lines, to commence the construction of a fleet of modern warships. The result is known to all citizens of this country, and while we cannot yet compete in power of ships or guns, even with poverty stricken Italy, we have just cause to take pride in the achievements of our naval architects and the builders of our armor and guns. We had literally to commence at the beginning, or, as some ill-advised counselers proposed, buy our war ships from European nations. We wisely chose the former course and set to work to create the establishments for providing and shaping the enormous masses of metal demanded by the conditions of modern construction. Some of the most intelligent and most experienced of our workers in iron and steel loudly complained of the high standards for metal and workmanship, laid down by the government and claimed that we were attempting impossibilities, that we had better go at once to those who had the experience and the machinery and knew how to handle the latter. This was only about seven years ago, and the plan last proposed would doubtless have been cheaper from a purely commercial standpoint; but great advances have been made in this time. We have shipyards on both coasts equipped for building the heaviest battle-ships the government may demand; and our gun foundries have already turned out guns of the smaller calibre that for power and durability equal the best of other nations, and in workmanship surpass them. We have commenced with built-up steel guns, with all the costly and extended experience of other nations before us, and have progressed as far as building up one of 12-in. calibre, even if we did have to go to France for the rough tubes and jackets. Several of our mills are rapidly fitting themselves with all the plant required for the manufacture of the heaviest armor plate and the forgings for the heaviest guns; and in a very few more years we can make all our own ships, and may, perchance, have a surplus to sell to other nations.

Notwithstanding the accusation made to that effect we have not blindly followed the practice of our brethren across the sea; such a course would be contrary to all the traditions of the Yankee race when it sets out to construct in any direction. We have used their experience freely and have doubtless profited by it, as was our opportunity; but in nearly every feature of our new ships and new guns we have attempted to improve upon the practice of others, in the standard of material, in the tools used and in the workmanship, and the general verdict is that we have succeeded. It is only a Yankee maker of rapid fire guns, for example, that can afford to throw away the usual small limit of error of $\frac{1}{1000}$ in. and contract to furnish a 3-in. tube that shall be absolutely without error. With abundance of capital, unlimited raw material of the highest grade, the most perfect tools and the experienced mechanics to make the most powerful plant required, it would be little to our credit did we turn out bad work.

So far not one of our war ships built has been a failure, and the later ones are the fastest and the best of their class in the world. In the protected cruisers Nos. 12 and 13, one of which is now under contract, we have struck out on lines that are novel, and have set the naval authorities of Europe to discussing their possibilities and the effect for evil of a fleet of similar vessels let loose upon the high seas in times of war. An armed ship of 7,350 tons, driven at a sea speed of 21 knots by triple engines and triple screws, developing 21,000 I. HP, with great coal endurance, is a type that is new, and a ship that could only be successfully checked in her career by a faster and heavier vessel still, a class of ship that does not exist in any navy. The triple screws to be used with this ship are not new, for they have been tried in small torpedo cruisers, and France is now building a vessel of 6,000 tons so fitted. It is not claimed by naval architects that they will give greater speed than twin screws, or even one screw driven by an equal power, but there are other advantages that especially commend this plan for use on cruisers of this type. To transmit the enormous power developed by the engines of this vessel, even twin screws would require shafting and fittings of almost abnormal proportions, with all the consequent cost and difficulties of manufacture and the inherent risk of breakage in service. But aside from this come the great advantages of a subdivision of power to meet the demands of cruising or the emergency of an accident to one screw, engine or shaft, and the avoidance of the wasteful attempt to run a large single or double engine at low power. Boilers can be fired and coal consumed as events may demand, and the United States Bureau of Steam Engineering, in designing these vessels, has provided three entirely distinct engines, one for each screw, and clutch coupling devices that will enable one or two screws to be detached and revolve without any marked interference with the way of the ship. This bureau estimates that with one engine and one screw a speed of 15 knots can be maintained; with two engines and two screws a speed of 18 to 19 knots, and the three screws and the full complement of engines and boilers will only come into play when the maximum speed of 21 knots is demanded.

It is vessels of this class, rather than the enormous floating batteries of the *Ramillies* type, that are needed by the United States; and to defend our coasts and seacoast towns against the heavier ships of other nations, if that time unhappily ever comes, we must depend upon harbor defenses, heavy army guns, where weight and length count less than aboard ship, and upon dynamite. Other nations have built guns of 110 tons and mounted them in turrets that with two of these guns weigh 900 tons or more. But the indications are strong that they are repenting of their ambition, and that the end has been about reached, if not passed, in the weight of ships' guns and ships' armor. One of these enormous engines of war, or the gun alone, costs over $100,000 to build, and nearly $1,000, or, more exactly, $890, for each shot fired from it. The strain upon ship and gun in actual service is almost past endurance, and this 110-ton gun is now credited by the best authorities with a lifetime of but 75 full-service charges. Even the 67-ton gun, the next in size, can be fired but 120 times with its maximum charge and projectile, or 400 times with a half charge. These are rather expensive playthings, and we little wonder that European nations are getting tired of them. But they must do as their neighbors do, and each must see to it that his watchdog is just as strong and has as efficient teeth as the dog of the man next door. We are more fortunately situated and can afford to expend our energies and capital upon heavy guns for land batteries in which there are not so many conflicting conditions to deal with. Torpedoes and dynamite cost far less, and one efficient shot even out of many is enough to blow out of the water the strongest ship that can cross the Atlantic, and the end is not yet with our dynamite throwers, in which America has again set the builders of big guns and expensive warships to weighing the chances and counting the cost.

WILLETT'S HARBOR, off Padre Island, coast of Texas, has just been surveyed in the interest of deeper water. The engineering party, under Mr. J. E. HARRIMAN, Jr., has returned to Corpus Christi, and reports a favorable location for the works. Gen. HERMAN HAUPT is Chief Consulting Engineer.

CORRESPONDENCE.

Battles and Rainfall.

CINCINNATI, Aug. 26.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Referring to your editorial of the 15th inst., on the government efforts to produce rain by artificial means, it seems well to call attention to one point that is pertinent to the subject but which hitherto seems to have been overlooked.

The chief basis for the expectations of the rain makers is the fact that rain frequently follows a battle. This sequence has been noted in the cases of a large number of modern battles, and it has been attributed to the use of gunpowder and the resultant disturbance of the atmospheric strata. But the same observation was made by ancient historians as to the appearance of rain after ancient battles, long before gunpowder was invented. It therefore follows that the explanation of the phenomenon must be sought in some cause that was equally operative in ancient and modern times, and concussion by explosion is not such a cause, and it therefore does not meet the conditions of the problem.

In my judgment the true explanation is very simple. Battles are usually the culmination of a series of marches and manœuvres, which are generally made during pleasant weather, and are never made during wet weather if it can be avoided. Battles are seldom fought in the rain, and in most climates a week of fair weather is sure to be followed by rain, if not by a storm. This explanation applies equally well to battles with or without gunpowder, and the irregularity of rain storms during the campaigning season fully accounts for the cases in which battles were not followed by rain.

Very truly yours,
WM. E. MERRILL.

River Profile Register.

MISSISSIPPI RIVER COMMISSION.
ST. LOUIS, Mo., Aug. 26, 1881.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of July 25 you give a description of "The Stecher River Profile Register."

A similar apparatus was designed by me several years since, as will be seen from my report to the Mississippi River Commission dated Sept. 20, 1884 as follows:

"I beg leave to submit sketches and description of a sounding apparatus, which I believe will add materially to the accuracy of profiles as determined by soundings.

"In order to study the peculiarities of sand waves it is desirable to have a continuous profile of the bottom, along the same line, at frequent intervals covering various changes of stage and condition of river. The difficulty of obtaining this is doubtless appreciated by all who have attempted it. On crossings, where the study of changes is of the greatest importance, the depth of water would admit of the use of a device, explained below, which would give a continuous profile on paper which could be compared directly with other profiles of the same section.

"It consists essentially of a piece of gas-pipe or an iron rod, one end of which is weighted and drags on the bottom, while the other end is fastened to a post attached to a boat. A pencil point is made to move along a roll of paper by means of a cord attached to the rod and held taut by a weight. The roll of paper is 'revolved by clock work.' . . .

"The line marked by the pencil point is directly proportional to the line followed by the foot of the rod."

The details are also given, but after what you have already published it will hardly be necessary to repeat them here.

Yours very truly,
J. A. OCKERSON.

Jacking Up a Concrete Catchbasin.

NEW GLASGOW, Nova Scotia, Aug. 26, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: We are putting down a system of sewerage in this town with all the necessary adjuncts. A mistake having been made in the placing of a concrete catchpit 6′ 0″ × 4′ 6″ × 3′ 6″ some 18 ins. out of its proper place, at first it was ordered to be broken up and removed in pieces, but the foreman, Mr. WENTWORTH C. MCDONALD, simply removed the earth around it, and placing jackscrews, moved the whole mass without a crack into its proper place and raised it one foot. I do not know that this has ever been done before, and give it for the benefit of engineers in future. Yours, etc.,

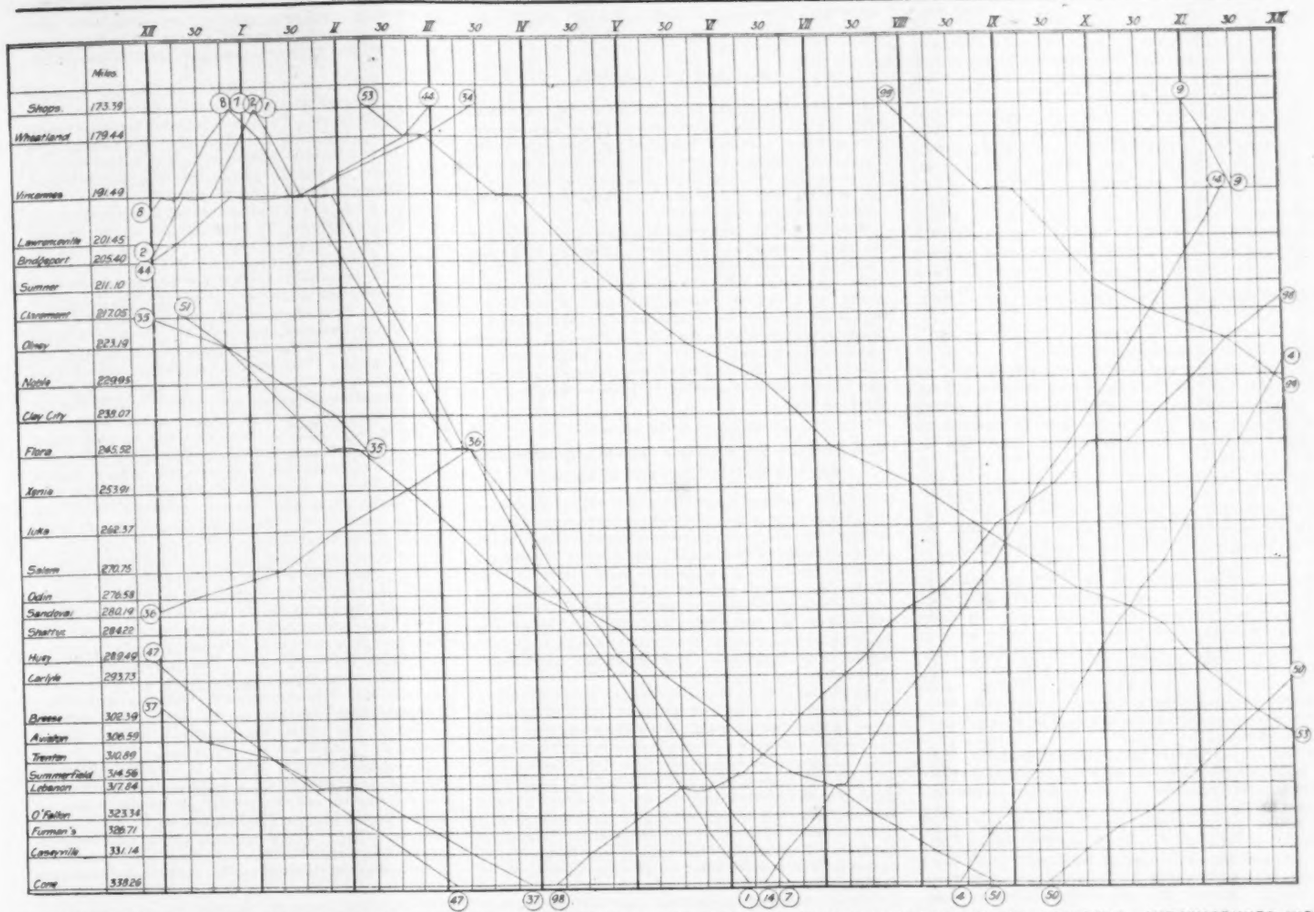
A. M. FRASER,
City Clerk.

Titles of Engineers.

KALISPELL, Mont., Aug. 26, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I have noticed in the recent issues of ENGINEERING NEWS the correspondence relative to engineering titles. Herewith I give you the organization of the engi-



TRAIN DISPATCHER'S GRAPHICAL RECORD OF TRAIN MOVEMENTS; OHIO & MISSISSIPPI RY., DIVISION BETWEEN EAST ST. LOUIS, ILL., AND VINCENNES, IND.

neering corps now engaged on the construction of the Pacific extension of the Great Northern Railway:

(1) Chief Engineer, in charge of the entire work.

(2) Division Engineers, in charge of portions of the road termed divisions, varying in length from 50 to 100 miles, and who report directly to the Chief Engineer. (3) Resident Engineers, in charge of from 20 to 40 miles, and reporting to the Division Engineer in charge. (4) Assistant Engineers, in charge of a portion of the work termed a section, varying in length from 6 to 10 miles, and reporting to a Resident Engineer.

In addition to the above there is an Engineer of Track and Bridges, who reports directly to the Chief Engineer.

All instrumental work is done and measurements taken by the Assistant Engineer. His party consists of a rodman, tapeman and one or more axemen, as circumstances may require.

J. A. B. TOMPKINS,
Div. Engr. G. N. Ry.

A Train Dispatcher's Graphical Record.

CINCINNATI, July 16, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: The graphical method of reporting the running of trains, of which an example is given on the accompanying sheet, is very simple and effective, properties peculiar to all graphic methods. The vertical lines represent the time; the horizontal lines are the station lines, which are the proper distance apart, by scale, represented by the miles between stations; the irregular lines represent the various trains running over a division of the road. When a train is reported to the train dispatcher from any station, a line is drawn from the intersection of the time and station line previously reported to the one then reported, which line represents to the eye the train running between those points. The successive points thus found and joined represent the train over the division. Every other train is represented in a similar manner. Thus, the relative position of every train with respect to any and all other trains running on the division is apparent at a glance. It reduces the possibility of two trains meeting between stations to a minimum. Indeed, it makes it impossible without having the lines intersect between stations. On the accompanying plan certain sidings are not given, but these may be supplied readily.

The application of the method is not difficult, and its advantage over the present method is apparent on slight inspection. For instance, the calculation of meeting and passing points of trains when they are behind their card time is done simply, rapidly and accurately, by the use of a protractor, which placed on the sheet will indicate at once what given speed will take a train to a certain point in a certain time, and what trains will be met or passed during this time. The recording of trains is made with equal facility as now, the only requirement being to place a fine-pointed pointer in the intersection point of the time and station line, allowing it to remain there until the line is produced from the last point to the point reported. Special trains can be economically run over the road with no interference with other trains and with greater facility and less danger of collision than by the method now employed. In short, from a confused array of columns of figures representing trains, now employed, this method represents at once to the eye each train as it makes its way over the line, and its progress is truly indicated by the lines on the sheet before the dispatcher. The method is respectfully submitted to the inspection of the transportation departments of railways.

L. C. FRITCH,
Assistant Engineer, Ohio & Mississippi Ry.

The Use of the Meridian in General Engineering Work.

TOLEDO, O., Aug. 29, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Your issue of July 18 contains an article that has greatly interested me. I refer to the "Determination of a Meridian," by W. L. MARCY. I think my friend, Prof. J. N. STOCKWELL, the veteran and distinguished astronomer, of Cleveland, once wrote a paper on a similar subject, viz., the "Determination of the Meridian from Circumpolar Stars," but I regret to say I have never seen it, though it may possibly have been published in the *Journal of the Association of Engineering Societies*.

The subject is one that I think commends itself to all interested in exact angular measurements on the earth's surface, and is by no means limited to those who wish merely to use such meridians as a check, or as a means of verifying the readings of the magnetic needle. As it is now, while every one of us is supposed to know how to take the meridian from the elongation and the culmination of Polaris, it is a fact that very little practical use is made of such knowledge, mainly because it involves night work and at irregular and inconvenient hours, which have to be determined by special calculation, and because of clouds one may have to sit up several nights before a successful observation can be had. Because of so much trouble, there is a very general use of the solar compass in the west, but the use of this instrument has not been extended to the east, or to general railroad or city work.

The Sims apparent movement is so rapid that one must work with great nicety, not merely of instrumental adjustment, but of latitude, time, etc., or the observation becomes a mere approximation, less exact in fact, than a good magnetic needle under normal conditions.

Now Mr. MARCY undertakes to make the position of Polaris easily calculable for a considerable range of time without waiting for it to assume a particular position, at possibly a very inconvenient hour, when lo! it may be hidden by clouds.

Thanking Mr. MARCY or what he has already done, would it be asking him too much to continue the good work, and favor us with a sort of time table or almanac, that we may in great part be saved from the drudgery of computing?

Some may object to the idea of having ready made tables of this kind, but I cannot see why they are not as legitimate a labor saving device as are any tables of logarithms or trigonometrical functions.

Very possibly the trouble of determining a meridian by the old-fashioned methods has been greatly exaggerated, but the fact remains that observations are rarely taken for such a purpose. There is, too, a vague idea that they are only valuable as related to needle-work. This is wrong, of course, but to make such observations come into the every day practical work of the surveyor and civil engineer they must be made easier, plainer and simpler, and when this is done the uses of such meridians will be multiplied a thousand fold. Why, for instance, when a railroad line is surveyed, and a series of angles taken, should not such angles be checked by the meridian as pointed out by Mr. CHASE and objected to by you?

Why should not the bearings of streets, of railway tangents, of section and land lines be directly and exactly deduced from the meridian? Not because such determinations would not be immensely valuable, but because the trouble until now has seemed too great. But it seems as if better methods were within our reach and that their extension and general use is sure to come about.

Very possibly Mr. MARCY or any other private individual may not have the time or inclination to work out such tables for us. The reward in sight may not seem

sufficient, though I am inclined to think, if really made available for extensive use, the publication would meet with a remunerative sale. If the subject is not taken up by private enterprise, what is the reason it cannot receive the attention of some government bureau—the Coast Survey Department, for instance?

This particular bureau prepares occasionally somewhat elaborate bulletins on various subjects, and among them several have been published on the subject of magnetic variation. This work has been done, I presume, under the impression that it would assist the surveyor, and may have some value; but as polar azimuths are as much superior in accuracy as distances obtained with a steel tape are to those obtained by pacing, I think any way of making it easy to use them would make surveying practically a new science. HOSEA PAUL.

English Railways: The Southeastern Railway.

LONDON, ENG., Aug. 14, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Though many curiously erroneous statements appear in American papers concerning English railway practice, generally written I should suppose by Americans who have acquired their experience entirely on lines south of London, I should imagine it impossible, Sir MYLES FENTON to the contrary, for any American, even of the most Anglophobic order, to write anything bad enough of the Southeastern Ry. True, he might, without fear of too forcible contradiction, say that it was not so bad as the London, Chatham & Dover Ry. in some respects, though it is a close struggle between them for the fame of Erostratus.

The Southeastern Ry. has in its hands the two finest sites on the planet for its main termini in London, viz.: Cannon St. and Charing Cross. It has known for years that its line was overcrowded and has done next to nothing to remedy it. All its cars almost without exception are filthy. Its trains are up and down in roof outline like a graphical diagram of shears, owing to the irregularity in size and style of the cars. Punctuality is almost unknown, speed is under half that of other lines, if not under a third.

Civility there is none, as Sir MYLES well knows or ought to. He soon would know if he went incog. to London Bridge next Saturday and enquired as gently as possible of one of the inspectors, "If you please, is this the Caterham train?" "No!" in a hoarse shout would be all he would get in reply. Southeastern Ry. rudeness is a by-word, and this line, the London, Chatham & Dover, and the London, Brighton & South Coast (or "London, Brighton & Cast Iron") lines are unique in their hopeless iniquity. It is precious small use sending in a complaint, or I could soon send on a regular supply. What notice should I get thereof? Just none.

It is a curious fact, but a fact, that only those lines running into London which have a north country connection are at y good at all. I know them all. Sir MYLES FENTON must think your paper has no English readers. I certainly missed seeing his letter or would have written earlier ANGLO-AMERICAN.

[The above is a pretty strong statement and a pretty severe arraignment of the road referred to, but it certainly represents a very general public opinion. This public opinion was alluded to in the article on the Southeastern Railway, published in our issue of May 23, and to which Sir MYLES FENTON, the General Manager, made objections in the letter published, with comments thereon, in our issue of July 4, in which reference was also made to the London, Chatham & Dover Railway. Judging from recent statements in the English papers the London, Brighton & South Coast Ry. is by no means the only one deserving the title of "cast iron" in regard to bridge practice. Our correspondent is scarcely just to the Southeastern Ry., as considerable improvements in the terminal lines and the rolling stock have certainly been made within the last few years, as pointed out in the issues of our paper above referred to, but it is equally certain that there is plenty of room for further improvements, in many respects to a larger extent than on some other trunk lines. Neither is our correspondent just to the southern railways in his sweeping statement in comparing them with the northern lines, the latter of which present many feature open to adverse criticism, as noted in the various articles on English Railways in the first volume for this year. Among the good features of the southern roads we may mention the modern track and locomotives of the London & Southwestern Ry., and the Westinghouse brake and Pullman car service upon the London, Brighton & South Coast Ry. As a matter of fact there is no railway in England so good as to be above criticism, and no railway so bad as to be sweepingly condemned. Our articles on the Southeastern Ry. and other lines have been of course quite impartial, presenting the good and bad features observed in every case.—ED. ENG. NEWS.]

Notes and Queries.

J. P. S., of Harriman, Tenn., writes us that a woman was arrested for some offence in that place and locked up for a day in a "so-called ventilated car," belonging to the Louisville Southern Railway Co., without permission of the company. The question put is, whether a town corporation has the right to use the property of a railway company for such a purpose?

[This is a case for lawyers rather than engineers. The car was appropriated as a prison, probably, by the corporation for their convenience only. But they had no more right, in our judgment, to so use this car than they would have had to convert the house of Mr. S. to a similar use, without his permission. The car was private property, and while we do not see just how damages would be laid, it was clearly a case of infringement of private rights. The corporation was a trespasser in putting the property of another to an objectionable use.—ED. ENG. NEWS.]

The Present State of Our Knowledge Concerning the Self-Purification of Rivers.*

There is, perhaps, no controversial matter connected with the hygiene of water supply to which engineers have so frequently had their attention directed as that of the self-purification of river water. Although it is a subject on which most water engineers have a very decided opinion, the present occasion appears to be particularly favorable for reviewing the whole question by the light of the most recent information, especially as we have the benefit of the presence of a number of distinguished colleagues from abroad, whose opinions on this much vexed topic will be very welcome.

The subject of the self-purification of rivers admits of being considered from two perfectly distinct points of view, as indeed do almost all other questions relating to the purity of water, viz., from the chemical and biological aspects. Inasmuch as the organic impurities—and the controversy, of course, only refers to organic impurity—gaining access to rivers may be either devoid of life and unorganized, or living and organized, their discussion is in the one case a chemical, and in the other a biological question. Until recently the subject has been only discussed from a chemical point of view, in consequence of the impossibility which formerly existed of obtaining any precise or accurate information upon such matters of biology.

The firm conviction possessed by many that rivers undergo spontaneous purification in the course of their flow is generally based upon personal observations made upon streams, in which the process appears to be going on in such a striking manner that no analytical evidence is required.

All engineers are acquainted with streams which are visibly polluted at one spot, and apparently pure a few miles lower down. When such cases are further submitted to analytical tests, the latter, of course, fully confirm the previous ocular impressions. In fact, that such disappearance of organic matter does take place is beyond all shadow of a doubt, and it is mere waste of time to contest it. A bag full of feathers shaken into the air at one spot would similarly be imperceptible a few hundred yards away. That the polluting matter has been destroyed, however, in the course of a few miles' flow is almost as improbable as that the feathers should have been decomposed in their short flight through the air. In fact, when these cases of supposed self-purification are carefully investigated, it becomes very doubtful whether the phenomenon is due to anything beyond dilution and sedimentation. The careful experiments which have been made to test this point are by no means numerous.

A series of investigations were made by the Rivers Pollution Commissioners of 1868 to test the point, both as regards highly polluted streams, such as the Irwell, Mersey and Darwen, and comparatively pure ones like the Thames, but in both cases their results were of a negative character, and pointed to no real purifications, *i. e.*, destruction of organic matter, although there was distinct evidence of considerable improvement in the quality of the water through sedimentation.

Some years ago I undertook a series of experiments to further test this point in connection with the Thames, which has always been regarded by some as a river possessed of most remarkable self-purifying power, and which undoubtedly often does reach London after a long flow through a cultivated and fairly populated district in a surprisingly pure state. The experiments in question consisted in taking samples of the water flowing in the river at different points on the same day, with a view to establishing whether on the whole the chemical quality of the water was improved or deteriorated during the course of its long flow. Thus, on one day, samples were taken at Oxford, Reading, Windsor and Hampton, on another day at Chertsey and at Hampton, and on three different occasions samples were collected both at Windsor and at Hampton on the same day. The results of analysis on these various samples are recorded in the accompanying table, and clearly indicate that the chemical quality of the water undergoes slight but almost continuous deterioration in flowing from Oxford to Hampton. It must be remembered that this deterioration is in spite of a very large increase in the volume of the water, a large proportion of which gains access to the river from springs in the chalk, and is of the very highest purity. Thus, Mr. Thornhill Harrison, C. E., has determined that the total increase in volume in the Thames between Maidenhead and Thames Ditton was (exclusive of the Colne, Wey and Mole):

*By PERCY F. FRANKLAND, Ph.D., B.Sc. (Lond.), F.R.S., Professor of Chemistry in the University of St. Andrews, Dundee. Read before the International Congress of Hygiene and Demography.

TABLE I.—RESULTS OF ANALYSIS EXPRESSED IN PARTS PER 100,000.

Description.	Total solid matters.	Organic carbon.	Organic nitrogen.	Ammonia.	Nitrogen as nitrates and nitrites.	Total combined nitrogen.	Chlorine.	HARDNESS. Temporary.	HARDNESS. Permanent.	HARDNESS. Total.
Nov. 4, 1883.										
River Thames, above Oxford	30.28	.136	.039	0	.178	.217	1.06	17.09	4.71	21.80
River Cherwell, 500 yds. above Thames	36.92	.305	.079	.016	.164	.256	1.44	20.86	6.29	27.15
River Thames, below junction with Cherwell	33.04	.158	.036	.010	.197	.241	1.17	19.43	5.57	25.00
River Thames, below Iffley lock	32.76	.165	.027	.002	.173	.202	1.20	19.16	5.14	24.30
" " Oxford	31.04	.161	.051	.004	.190	.224	1.18	19.59	4.71	24.30
" above Reading	33.32	.183	.025	.007	.255	.286	1.23	20.72	6.43	27 15
River Kennett, at junction with Thames	27.80	.128	.036	.008	.215	.257	1.26	19.44	4.86	24 30
" at Reading	29.24	.125	.030	.014	.220	.262	1.26	21.13	4.57	25.70
" " near drain-pipe	30.84	.256	.064	.033	.232	.325	1.60	19.73	4.57	24.30
River Thames, just above Windsor	31.80	.224	.038	.001	.219	.258	1.32	20.31	6.14	26.45
" at Hampton	30.52	.254	.047	.001	.204	.252	1.43	16.99	5.86	22.85
Nov. 17, 1883.										
River Colne, branch in Staines	36.84	.318	.062	.019	.266	.344	1.45	23.7	3.4	27.1
" main stream at junction with Thames	31.52	.236	.046	0	.254	.300	1.45	22.8	3.6	26.4
River Thames, above Staines Gas-Works	32.92	.242	.035	.003	.202	.239	1.33	20.1	5.6	25.7
" just above Staines	32.40	.230	.036	.004	.194	.233	1.40	19.9	5.1	25.0
" just below Staines	31.12	.245	.034	.001	.209	.244	1.36	20.8	4.9	25.7
Jan. 2, 1884.										
River Wey, at Weybridge	20.44	.270	.085	.030	.223	.333	2.00	9 3	4.7	14.0
River Thames, at Chertsey	34.16	.187	.047	.014	.287	.346	1.45	20.3	4.2	24.5
" at Hampton	31.92	.186	.035	.008	.281	.322	1.48	17.5	4.0	21.5
Jan. 9, 1884.										
River Thames, above Windsor	36.68	.197	.045	.003	.193	.240	1.47	20.3	4.2	24.5
" at Hampton	34.88	.227	.087	.008	.229	.323	1.52	19.1	3.9	23.0
Jan. 13, 1884.										
River Thames, above Windsor	36.40	.291	.063	.010	.227	.298	1.50	18.8	5.7	24.5
" at Hampton	33.56	.309	.055	.020	.226	.297	1.52	17.3	6.0	23.3
Jan. 28, 1884.										
River Thames, above Windsor	28.72	.478	.098	.014	.223	.332	1.7	13.6	6.4	20.0
River Thames, at Hampton	29.76	.451	.082	.024	.222	.324	1 7	13.6	5.3	18.9
River Thames, above Windsor (average)	33.55	.275	.058	.008	.230	.295	1.49	18.66	5.33	23.19
" at Hampton (average)	32.13	.285	.061	.012	.232	.304	1.53	16.90	5.01	21.91

TABLE II.—RESULTS OF ANALYSIS EXPRESSED IN PARTS PER 100,000.

Description.	Total solid matters.	Organic carbon.	Organic nitrogen.	Ammonia.	Nitrogen as nitrates and nitrites.	Total combined nitrogen.	Chlorine.	HARDNESS. Temporary.	HARDNESS. Permanent.	HARDNESS. Total.	Number of colonies obtained on cultivation of one cubic centimetre of water.
No. 1.—Taken from River Ure, above Ripon, 27 miles above intake of York Water-Works. The River Ure rises on the western extremity of the North Riding of Yorkshire, passing on its way only small towns and villages.	24.08	0.108	0.029	0	0.075	0.095	1.1	13.4	4.9	18.3	1,800
No. 2.—Collected about 16 miles above intake of York Water-Works, and about 3 miles below Boroʻbridge, and 10 miles below Ripon, both discharging some sewage into the Ure.	31.20	0.118	0.028	0	0.123	0.151	1.6	12.9	7.1	20.0	
No. 3.—Collected from River Ouse opposite the intake of York Water-Works. Between the point of collection of No. 2 and this sample there is no town, and only one small river, the Nidd.	28.40	0.123	0.025	0	0.077	0.102	1.6	11.5	7.1	18.6	31,200
No. 4.—Sample of water as supplied to York by the York Water-Works.	26.20	0.119	0.022	0	0.089	0.111	1.6	10.9	7.1	18.0	122

In April, 1884	249,500,000	galls. per day.
On July 8, 1884	43,000,000	" "
July 22 to 26	131,000,000	" "
November, 1890	45,000,000	" "

(Harrison) on Subterranean Chalk Water, Inst. Civil Engineers, 1891.)

In the above experiments I purposely limited the scope of my inquiry to the dissolved organic matter, so as to avoid the complications arising from the suspended matters, concerning the removal of which by sedimentation there is no dispute. On this account all the above samples were filtered through Swedish paper before analysis. Indeed, it cannot be too strongly pointed out that unless the questions of dissolved and suspended matters are kept wholly distinct in these investigations, no reliance whatever can be placed upon the results.

From the analyti cal table it will be seen that the idea of any striking destruction of organic matter during the river's flow receives no sort of support from my experiments, the evidence is in fact wholly opposed to any such supposition.

I have also had an opportunity of making a somewhat similar experiment on the flow of the Ure and Ouse above York, the results of which are recorded in Table II.

In this experiment also there is not the slightest support to the theory of self-purification. Nor is there any diminution in the number of microbes during the observed flow.

Of foreign investigations of the same subject, there are those of HULWA on the Oder at Breslau (*Chemical News*, 1883, 104; *Biedermann's Centralblate für Agriculturchemie*, XIII., Pt. I.), of FRANK on the Spree at Berlin (*Zeitschrift für Hygiene*, 1887, III., 355), and of PRAUSNITZ on the Isar at Munich (*Centralblate für Bakteriologie*, 1890, VII., 404).

Of these investigators, HULWA professes to have traced the complete purification of the Oder from the sewage of Breslau after a flow of 32 kilometres. It is impossible to make any use of these results without a knowledge of the changes which the volume of water in the river undergoes during this flow.

A most complete account of the condition of the Spree during its flow from Berlin to Potsdam is given by FRANK, full account being taken of the changes in volume during the course.

The results arrived at by FRANK are, however, very different from those of HULWA, for FRANK maintains that the change in chemical composition is very insignificant throughout, but that the number of microbes undergoes a most striking diminution during the flow, a result which he naturally attributes to sedimentation. Already, in 1885, I had myself ("On the Removal of Micro-Organisms from Water," Proceedings Royal Society, 1885, No. 238) shown to what an astonishing extent micro-organisms are removed in the subsidence of solid particles; this I had proved, not only in the case of laboratory experiments made with the most varied materials, but also on the large scale in the softening of water by Clark's process. The disappearance of the microbes in the water of the Spree during its sluggish flow through the lake-like extension which it forms after junction with the Havel at Spandau, above Potsdam, is obviously due to causes of a similar kind. In the experiments of PRAUSNITZ on the Isar at Munich, there is the same disappearance of microbes during the flow, which is again attributed to sedimentation.

A careful study, therefore, of these most recent investigations leads us to the inevitable conclusion that sedimentation is the main cause of any self-purification in river water. Of any rapid oxidation of dissolved organic matter there is still no reliable evidence, although, of course, dilution, which frequently takes place on the largest scale, as in the case of the Thames, without being suspected until made the subject of the most careful scrutiny, will produce a superficial appearance of such a result.

This removal of microbes by sedimentation during the flow of a river is unquestionably of great hygienic importance, and of much greater hygienic importance than the alleged oxidation of dissolved organic matter, which in itself can have no power of communicating zymotic disease; it is, however, a process which cannot be relied upon as furnishing any guarantee that harmful microbes turned into a stream at a given point, will no longer be present in the water at any point lower down.

From the numerous experiments which have been made on the vitality of pathogenic microbes in water, there can be no doubt that many forms which might have subsided as above indicated would remain alive for long periods of time, and be carried down uninjured when the river was next in flood. Indeed, recent experiments of Lortet ("The Pathogenic Bacteria of the Mud of the Lake of Geneva," *Centralblatt für Bakteriologie*, IX., 709) have shown that such deposits formed in lakes actually, and not unfrequently, contain pathogenic forms in a state of vitality.

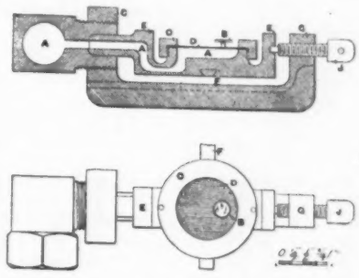
We must not allow, therefore, this sedimentation of microbes to cause us to relax our protective measures to exclude contamination from our streams, but on the contrary, bacteriological research clearly indicates on the one hand, the value and importance of purifying by the very best available means all dangerous liquids, such as sewage, before admission into rivers and, on the other hand, to submit the water drawn from streams for town supply to the most careful subsidence and filtration through sand before delivery.

A Novel Steam Engine Indicator.

The ordinary steam engine indicator consists of a small cylinder to which the steam is admitted and presses against a piston, on the other side of which is a small spring. The length of movement of this piston varies according to the pressure of the steam, which deflects the spring. Then if a card is given a horizontal motion corresponding to the travel of the piston and a pencil attached to the piston of the indicator moves against the card, the ordinates of the line which it draws across the card will correspond to the pressures of steam in the cylinder at different points of the stroke.

The defects of even the most perfect forms of the indicator when used for taking diagrams from high-speed engines are well known. Among them are the inertia of the moving parts and lost motion in the connections. With the idea of reducing these defects and furnishing an indicator better suited to studying the work of high speed engines Prof. PERRY, of Finsbury College, England, has designed an indicator working on a different principle. In place of the cylinder and piston is a closed chamber, on one side of which is a thin flexible diaphragm of steel. This is pressed outward by the steam pressure, thus corresponding to the piston and spring of the ordinary indicator, but being much lighter and moving without friction.

To accurately magnify and record the motion of this disk, an instrument is employed similar in principle to a reflecting galvanometer. A concave mirror is so mounted that it is turned on its axis by the movement of the disk and is also given a reciprocating movement corresponding to the stroke of the piston. The mirror throws a pencil of light upon a screen placed the proper distance away; and as it is moved by the action of the engine and the pressure

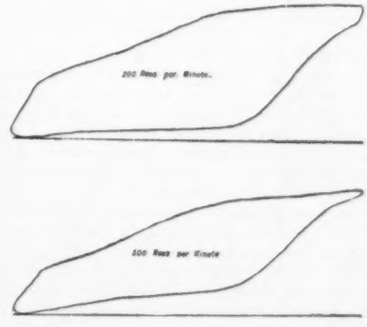


Figs. 1 and 2. Perry's Steam Engine Indicator.

of steam upon the disk, the spot of light upon the screen traces a diagram similar to an ordinary indicator diagram. By using a ground glass screen the diagram may be readily traced, or it may be photographed if desired. The more common use for such an indicator, however, would seem to be as a permanent attachment to the engine, enabling the engineer to see at any time just what form of card the engine was making, and to study closely the effect of changes in valves, steam pressure, etc.

The illustrations accompanying show respectively a section and plan of the instrument; and sample cards taken with it, at the speeds noted. We are indebted to *Industries* for these illustrations.

We do not understand that the invention has yet progressed beyond the experimental stage; for although it has been applied with some success to the indication of several engines, the instrument has not yet been put in form suitable for general use.



Figs. 3 and 4. Sample Diagram Taken With Perry Indicator.

The idea, however, is a most ingenious one, and it is to be hoped that it may be found feasible to develop and perfect it. The gain which would result by having an engine draw an indicator card at every stroke, as plainly visible to the engineer as the steam-gage, would certainly be very great; and it is also possible that the new device may be perfected to greater accuracy than is possible with the piston indicator in ordinary hands.

The Largest Dry Dock on the Lakes.

The Detroit Dry Dock Co. have now in course of construction, and about two-thirds completed, what is said to be the largest, most convenient and strongest dry dock on the entire chain of lakes.

The interior dimensions of this large wooden dock will be 380 ft. long on the keel blocks, 55 ft. wide at the bottom and 91 ft. at the top. In the construction over 2,000 piles have been used, and they are driven over every 6 ft. square throughout the entire area of construction. As a preliminary undertaking there was formed a puddle wall 8 ft. wide and back 12 ft. from the edge of the dock, after piles had been driven; the filling in was done with blue clay puddled in a concrete mass and packed in from a depth below the level of the river bed up to the surface ground and connected to the outer cribs outside of the dock gate. The bottom of the dock is driven closely with piles, on which are mortised 12 by 12 in. frame logs; a sheathing of inch pine is then laid, on which the flooring of 12 by 4 in. oak laps over the seams of the sheathing.

The pumping apparatus, to which Superintendent PARKER points with pride, is unequaled on fresh water. The dock will contain upward of 3,500,000 galls. of water, and a pump well 35 ft. deep, 25 ft. long and 11 ft. wide, built with 12-in. oak timber, is supplied by a brick tunnel from the dock, 5½ ft. in diameter. To lower the level of this chamber there are two centrifugal pumps, each having a discharge of 30 ins. in diameter, and worked by two separate Westinghouse engines of 150 HP.

The steel pontoon gate which is now being built at the Wyandotte shipyards of the company is 80 ft. long, 20 ft. deep and 12 ft. wide, weighing 75 to 80 tons, and requiring about 160 tons of concrete and scrap iron to ballast.—*Marine Journal.*

French Pier Masonry and Bridge Detail.

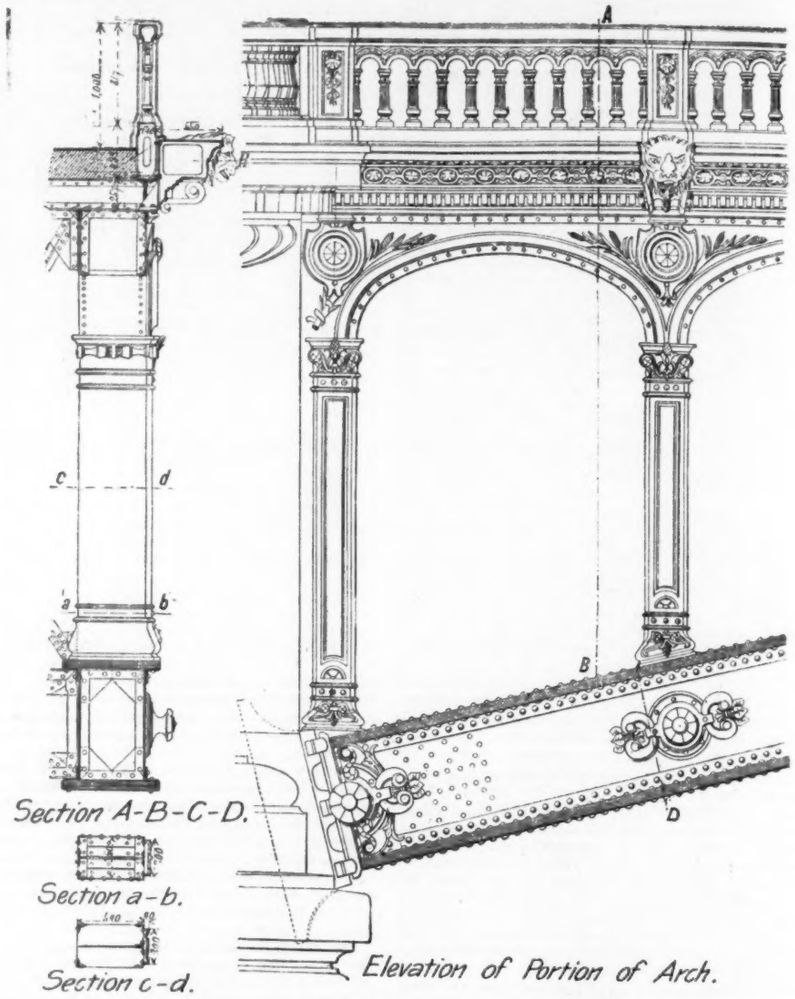
In 1774 a bridge was built across the River Rhone near Lyons, France, by the architect MORAND. It proved too narrow for modern traffic, and in 1889-'90 it was replaced by three steel arches with two river piers of stone of graceful design. The general dimensions are given by *Le Génie Civil* as follows: Central arch, span 221 ft., radius, 426.77 ft.; side arches, 210 ft. span, 417.4 ft radius. The entire bridge, taken on the roadway line, conforms to the arc of a circle of 5,206 m. radius, and meets the approach walls with a gradient of 2 cm. per meter. This was done to correct the appearance of deformation due to the lowering of the arch crowns in extremely cold weather by the contraction of the metal. The bridge is 65.6 ft. wide from out to out of parapets.

The interesting features are the design of the stone piers, which is exceedingly effective, and the general arrangement of the skew backs for transmitting the thrust of the steel arches. The piers were founded on caissons, sunk by the pneumatic process, each caisson being 21.3 ft. wide and 98 ft. long. The soil penetrated was made up of alternating layers of sand and gravel.

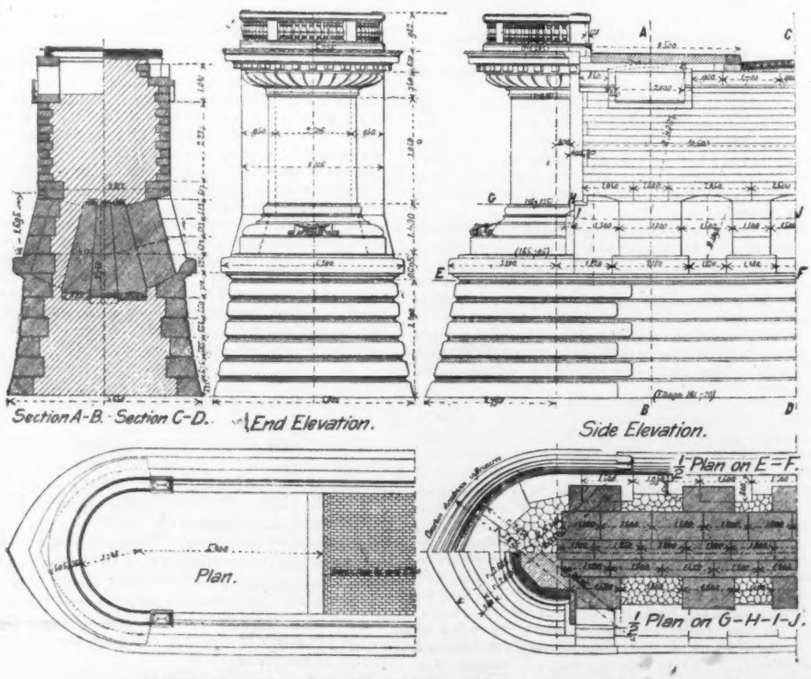
The piers terminate in ogival cutwaters, as shown in the cuts, and are surmounted at the ends by columns of rose-colored Scotch granite, 8.5 ft. in diameter and 10 ft. high. These columns are capped by a semi-circular balcony or refuge bay, as shown. The abutments are formed by making them wider than the bridge proper and connecting the two ends to the bridge and approach walls by quarter columns of granite similar in design to those shown for the piers. The roadway was paved with wood blocks, 5½ ins. thick, placed upon 6 ins. of beton. The footways (14.75 ft. wide) were made of beton covered with asphalt.

While we do not propose to go into all the detail of the metal arches, the treatment of these arches, from a decorative standpoint, is well worthy of note, and we give the first pier panel as an illustration. Each span was made of eight arches, of the dimensions given, spaced 8.5 ft. apart, *C* to *C*, under the roadway, and 10.8 ft. apart under the sidewalks. The arches were identical in section, and the equal distribution of load was secured by this spacing.

The decoration of these arches has been carefully studied, and carried out in a manner that indicates plainly the general system of construction. The bold, projecting bosses, in the outside arch, show where these are connected with the inner arches. The posts supporting the roadway are handsomely designed, and the flat arches connecting these posts are simple in outline and decoration. The cornice projects so as to throw a deep shadow line, and to break the length of this cornice and to facilitate the connections, over each post is a lion's head project-



SOME ORNAMENTAL DETAILS OF THE RHONE BRIDGE, NEAR LYONS, FRANCE.



PIERS OF THE RHONE BRIDGE, NEAR LYONS, FRANCE.

ing out from the cornice line. The balustrade, with its little arches and columns, corresponds well with the work below it. Altogether it is a handsome piece of work, and the general result, as seen from the general view, is an exceedingly graceful bridge.

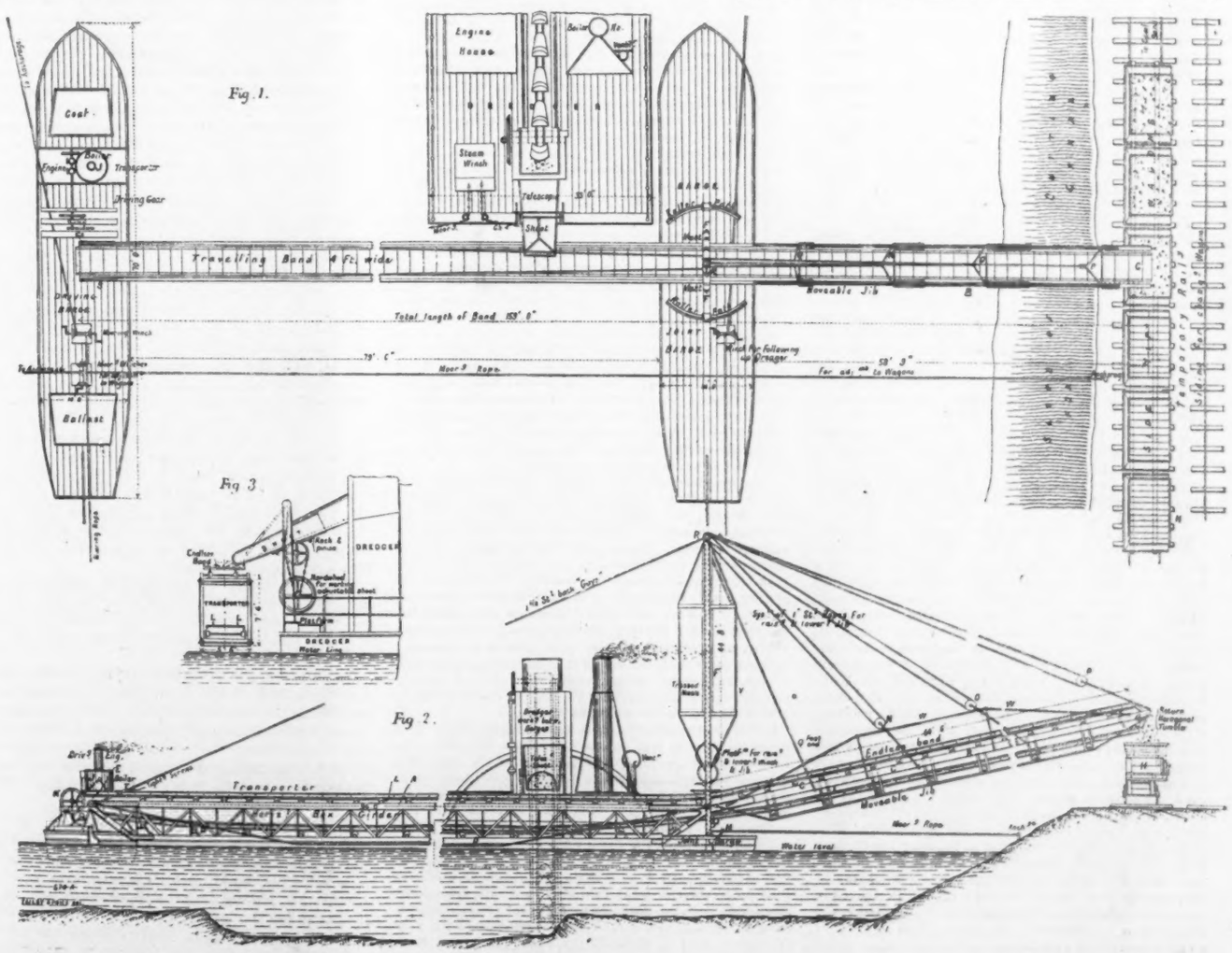
Dredger and Soil Transporter at the Manchester Canal.

We give from London *Engineering* a dredger, with apparatus for distributing the soil into wagons or depositing it onto the bank. This machine, which has been designed and constructed by Mr. John Price, Grappenhall, Cheshire, chief agent for the six lower sections of the Manchester Canal, and is being worked by him at Warburton in connection with section No. 6. The transmitting appliance is being pretty severely tested, as the material is thick, blackish mud, sand and clay. Another machine, of which the drawings are reproduced, is under construction. It consists, primarily, of a long horizontal trussed wooden box girder *A*, Fig. 2, 94 ft. long, 5 ft. wide and 6 ft. 6 in. deep, supported at its extremities by two decked barges, 70 ft. long, 14 ft. beam and 3 ft. 3 in. load draft. Jointed to the upper flanges of this girder, at one end, is a movable jib *B*, trussed, and suitably stiffened as shown. Both the girder and the jib carry an upper (*C C C*) and a lower (*D D D*) set of steel shafts and flanged rollers, over which travels an endless band, which is of wood in the case of the dredger already constructed. This band passes round a hexagonal driving tumbler *E*, at one end of the girder *A*, along its upper member, where it receives, at any point between the two barges, the excavated meterial, and passing under the masts *F F* along the movable jib *B* of the extreme end, and round the return (*i. e.*, idle) hexagonal tumbler *G*. Here it discharges its loads into the wagons *H H H*, or onto the bank. The band then returns along the lower side of the jib *B*, being carried by flanged rollers and spindles *D D D*, hung from the jib timbers by the bent angle-iron bearers *I I I*. A cross-section of the girder with endless band is shown in Fig. 3.

On the driving barge, as shown on Fig. 1, there is fixed a 10 HP. combined engine and vertical boiler *J*, the driving shaft being placed "fore and aft." The power is transmitted to the driving tumbler *E* through an intermediate shaft *K*, the pinion and spur ratios being such that while the engine runs at 120 revolutions per minute, the driving tumbler rotates at 5½ revolutions per minute—the endless band is carried round at a speed of 66 ft. per minute, the pitch of the chain and tumblers being 2 ft. It may here be noted that to obviate damage to the driving gear and machinery through any obstacles (as a large stone or bough) suddenly checking the band, a friction gear is provided on the counter-shaft, consisting of a disk within the spurwheel, driven by the latter through the medium of six adjustable lock-nutted setpins with blocks which slip on the disk surfaces if anything occurs. The wooden traveling band is bolted onto two endless wrought-iron chains *L L* in Fig. 3, 3 ins. deep, 1 in. wide and 2 ft. pitch. The band is 4 ft. wide by 8½ ins. deep and is built up of elm boards and sides firmly bolted onto the bottom and protected on their upper surface by half-round iron strips 2 ins. wide. These band sections are carried on the upper rollers *C C C* directly by the chain; but on the lower members of the girders *A* and *B*, where they are naturally inverted, the iron-bound sides of the band bear on the rollers *D D D* instead of the chain. The band is thus about 330 ft. long and is provided at every other section with a 6-in. cross-ridge to carry the wet material up the movable jib when the latter is at its maximum angle and prevent it from slipping down. It will be afterward seen that the angle of the jib will increase when the water is low or the cutting increased in depth. The joints of the band are covered with a thin iron plate to prevent undue spilling and to lessen the wear on the edges of the wood. The chain joints are provided with hardened steel renewable bushes 1¾ ins. external diameter and 1¼-in. steel pins, with square heads and split cottars. The chain travels on flanged steel rollers 7 ins. in diameter, keyed onto steel spindles 1⅝ ins. in diameter running in cast-iron bearings or sleeves, run with ⅛ in. of white metal.

The main girder is carried at the driving barge end on heavy annular bearings, thus admitting of a considerable angle of oscillation of the barge without subjecting the girder to undue stresses. The driving tumbler shaft passes through this bearing to the spur wheel. On the other or joint barge, however, the girder is rigidly bolted to the lower ends of two upright masts (trussed and stiffened), about 45 ft. high, carrying at their upper ends sheaves over which a system of 1-in. steel wire ropes runs to other sheaves fastened at four points along the movable jib. These two masts are firmly stepped into a heavy cast-iron base, resting on a central bearing and two rollers at the end, which transmit the whole weight of the structure to a circular roller path on deck (Fig. 1). This vertical center bearing pin lies on a hemispherical steel bearing plate at the bottom of a large square base plate *M*, bolted to longitudinal keelsons in the barge. This roller path arrangement is designed to admit of any differential movement in the horizontal plane of the two barges, which might take place in the event of failure of the moorings of the barges, which would cause a swinging movement of the barges under the structure.

As will be seen on reference to Fig. 2, there is at the lower end of the masts, and immediately above the loaded band, a strong hand winch, turned from the two platforms. The 1-in. steel rope passes from the drum upward between the masts over the top sheaves, and downward to, and upward from, the successive sheaves *N O P*, which are affixed to the jib by bridles bolted to the under side of the jib framing. The steel rope terminates at the bridle *Q* nearest the masts. The winch, the handle shaft of which rotates about 26 times to one revolution of the drum, is sufficiently powerful to enable four men to lift the whole of the loaded jib, weighing 23 tons, with ease, the speed of lowering and raising being slow. The maximum and minimum elevations of the jib, as constructed, are about 1 in 4 and 1 in 13 respectively, the lowering being effected by a strong strap brake on the winch. The whipping stress on the masts, due to the steel ropes carrying the jib and load, is balanced by two 1⅝ in. steel wire ropes running from the sheave casting *R* to the bearing side plates *S S* at the driving end of the girder. These ropes, carrying a tensile stress of about 16 tons,



SOIL TRANSPORTER, MANCHESTER SHIP CANAL

are capable of being tightened by the screws *T T* as shown.

At the upper end of the jib is an arrangement connected with the bearings of the steel hexagonal tumbler *G* for "taking up the slack" of the band when putting the machine together, or to allow for subsequent wear of the chain bushes and pins. This arrangement consists of two heavy side blocks, between two angle irons on either side of the jib as shown (Fig. 2). The bearings of the tumbler *G* are in these side blocks, which can be traveled through about 3 ft. by two strong capstan-headed screws working through nuts carried by the fixed slides.

The masts of the transporter, at present working, are rough larch poles 15 ins. in diameter at the butt and 9 ins. at the sheaves; they carry a working load of about 23 tons. They are greatly stiffened by struts and 1¼-in. wrought-iron tie rods in the one direction and the timber struts and diagonal bracings in the other. The main girder (which is light for its length and load) is composed of four 12-in. × 4-in. pitch pine timbers 93 ft. long, this length being with two long scarfs and deep iron side plates. These timbers are stiffened horizontally and vertically by 4-in. × 4-in. diagonal and 1-in. vertical and horizontal wrought-iron tie rods. The joint between the diagonals and the longitudinals is provided with light cast-iron sockets like the letter T to prevent the end grain of the former forcing itself into the fibers of the longitudinals with the shocks the girder is subject to owing to oscillating. This prevents a heavy sag of the girder. The cross-section of the longitudinals of *A* and *B* girders is kept as nearly perfect as the construction will allow by reducing the bolts as much as possible, and by securing all fastening, as tie rods, bridles, etc., to the under side. All cross stresses are avoided by duplicating the tie rods as back guys and bridles so as to pass on each side of the timber and be connected by a pin underneath. The girder *A* is further stiffened by 2-in. wrought-iron tie rods passing beneath the lower framing, the girder *B* being similarly stiffened by a bar-iron tie connecting all the hangers *I I I*. The movable jib is made of two 12-in. × 4-in. timbers (pitch pine) 65 ft. long, stiffened by transoms and diagonals, and upper tie rods *W W* which come into tension on lowering the jib. The effect of the load on the jib is much reduced by the system of ropes and sheaves to various points along the jib. The girder and jib carry a live load of about 22 and 17 tons respectively, the loads on the former, of course, varying with position of dredger.

The driving end of *A* is, as already stated, carried by two strong annular bearings sliding into, and supported by, two triangular girders, bolted down to the deck beams of the barge, and riveted together. The barges are provided with three winches, two controlling iron mooring ropes passing round the dredger to mooring posts up stream to enable the transporter to be kept at the correct distance from the dredger, to insure accurate deposition of the material without undue spilling. The other winch controls wire ropes across the river, and keeps the barges in the right line for the discharge of the materials over and into the wagons or moving hopper. The wagons, preferably side tipping, may be provided with additional sloping sides and ends, colloquially called "shirt collars," so that adjacent wagons nearly touch at these edges when the wagons are close together. With this machine it is necessary to push the wagons of the set along at the completion of the filling of each wagon, as of course the quantity of material in a 12-ft. advance of the dredger is much greater than can be deposited in one side wagon 12 ft. long.

A word may here be said about the dredger employed on the canal cutting when the transporter is working. It is a bucket and ladder (central) dredger built near the riverside; it was constructed in two sections to admit of its passing through the locks, and connected together and fitted up at the site. It is by Messrs. Fleming & Ferguson, of Paisley, with a capacity of 500 tons an hour; the main dredging engines have cylinders 14 ins. and 29 ins. in diameter (high and low pressure respectively) with a stroke of 20 ins., and work with a mean boiler pressure of 95 lbs. per sq. in. at about 130 revolutions per minute. In place of the usual port and starboard shoots, it has been fitted with a single telescopic stern shoot (Fig. 3), as, with the transporter, no time is wasted in waiting for barges, the taking away of the loaded set of wagons and replacing with an empty set being identical operations, and therefore productive of no delay at all. This stern shoot consists of an adjustable trough, sliding within a rigid one to the extent of about 3 ft., the telescoping being effected by a rack and pinion worked by two sprocket wheels and an endless chain, with a lower shaft and handwheel. The attendant standing at the shoot can thus advance or recede the adjustable portion of the shoot, and so govern the point of discharge of the dredged materials. The band travels at the rate of about 66 ft. per minute, at this rate equaling in capacity the dredger with a bucket speed of about 72 ft. a minute. Ordinarily, the discharged material contains about 40% of moisture; nearly the whole of this is lost in traveling along the inclined jib, and the material is deposited in the wagons in a very compact condition. This in itself is a very considerable economy, as compared with the usual delivery into barges and re-excavation by hand, or conveyance out to sea in hopper barges.

Naturally the power required for driving the traveling band varies with the load and angle of the jib, but in the transporter, as constructed and working at Warburton, two cylinders, 7¾ ins. in diameter and 12-in. stroke, with a cut-off at about ¾-in. stroke, a boiler pressure of 60 lbs. per square inch and a speed of about 120 revolutions per minute, suffice to drive the band at the above-mentioned speed; the average coal consumption is 30 cwt. per day of ten hours. The general principle of the transporter could with advantage be applied to excavation in the dry, the material being discharged by the grab or steam navvy into a hopper, which would discharge it onto a short horizontal length of band with the usual movable jib pointed to it; the whole structure of the transporter being nearly balanced on a bogie frame traveling on the same rails as the navvy, the driving tumbler being connected to an intermediate shaft of the navvy by an ordinary Hookham's coupling. The material would be deposited in wagons on an overland route on the top of the cutting. In this case the band would be 18 ins. deep, with 12-in. crossbars, and the maximum angle of inclination about 1 in 2½. This arrangement would only require a short length of single railway at the bottom of the cutting in place of the usual roads, viz., filling road (with its laborers for cutting away the bottom of the slope for same), jump roads leading to above, coal and water road, and the long leads and reverse inclines to the top level.

As regards the method of working, sufficient flotation for the transporter barges must first be made (before the transporter can be erected) by discharging from the dredger into barges or using a grab mounted on a pontoon. Two shallow pits, one for each barge, are all that is requisite; then the transporter can be erected on the barges. The dredger will then commence to excavate between the two barges, moving transversely between them and depositing the excavated material behind it on the band. It is then necessary (in order to advance longitudinally up the river) to cut further flotation for the barges by turning the dredger round slightly so that the edge of the excavation cut by the bucket is slightly outside the line of the barges; this done, the central portion can then be excavated as before, the transporter being kept in its position until the dredger again advances. This cutting away to allow for transporter barges flotation depth will be seen in the upper perspective view. In the case of the transporter working on the Manchester Ship Canal at Warburton, it is of such a length that one-half of the canal (say 100 ft. wide) is dredged at once, the jib barge being nearly over the foot of the slope. The slope thus forms itself at the natural angle of repose of the material in water, and the one half being completed, the transporter is then turned round, and the cutting completed, the material being discharged on the other bank. Thus the ordinary traffic of the river can be carried on during the time the transporter is working, and directly the one half (longitudinally) of the river is complete, in the event of the other dry cuttings having been completed previously, the canal may be opened and the traffic carried on past the transporter in the deepened channel until the whole canal is finished. As regards economy, it may here be stated that before the transporter was designed, the dredger was discharging into barges, which were then towed to the river's edge, and the material re-excavated by hand. In consequence of the large amount of water the effective capacity of the barges was but 18 to 25 tons, the amount being still further reduced at very low water. Owing to these delays the maximum weekly output was about 1,100 cu. yds. with about 60 men. With the transporter, however, 12 or 13 times this amount weekly, with one-half the number of men, and at much less cost, is possible.

The labor necessary for working the dredger and transporter is as follows: Dredger—one foreman, one captain, one engineer, one fireman, three men working mooring winches, one man working adjustable shoot, and two general laborers. Transporter—Driving barge: engine-driver, stoker, three winchmen and two general laborers; joint barge: four laborers for working mooring and jib-raising gear. Bank—one ganger, 11 laborers and boys, trimming wagons and hand-filling any spilt material, working points, shifting moorings, etc.; one locomotive driver, one stoker, and one rope-runner, for running wagons under machine, and 10 or 12 laborers on spoil bank for tipping wagons, slewing roads, etc.; and two locomotive drivers, etc., for the long leads to the spoil bank, on which the side wagons are to be tipped.

It will thus be seen that this machine is specially applicable to large inland canals intersected by rivers. In many cases rivers are cut through in order to get water to make up waste in locking; it will then be found much more economical to flood the cutting at this point and complete the excavation below water level with the dredger and transporter than to acquire extra land, cut a river division, tip dams across the ends, and then to pump the old river bend out, and do the excavation in the dry. In fact, it is quite possible to dredge a river to the correct canal formation without materially interfering with the ordinary traffic of the river. Endless bands fixed onto and worked by dredgers have been, and are being, used in Holland, the Suez Canal, and elsewhere. They deliver direct on the bank, and are thus restricted in their action; the material is also not deposited in any regular form. In wide inland canals this arrangement, however, would be useless, as it would be too far from the center of the stream to the bank, and, moreover, the material is required to be discharged into wagons, thus making the banks of the canal available as valuable quay space and lightening the slopes.

In conclusion, it may be stated that, to increase the work done by the transporter, now so successfully working at Warburton, the capacity of the transporter being so much greater than that of the dredger, it has been decided to fit up two Priestman's grabs on barges or pontoons, and to discharge the material so excavated onto the endless band of the transporter. This will increase the total amount excavated by at least 50 per cent.

The Halpati Reclamation Scheme in Florida.

The Halpati Sawgrass, containing over 113,000 acres, in Brevord Co., Fla., has been bought by the San Sebastian Sugar, Land & Improvement Co. from the State of Florida.

It is the intention of the company to reclaim this immense area by building levees and digging canals to drain off the surplus water, and Mr. J. FRANCIS LEBARON, late First Assistant Engineer in charge of the Nicaragua Ship Canal, has been engaged as consulting engineer to prepare a project for accomplishing this purpose and to lay out the work.

This sawgrass pond is at present an impassable swamp forming the extreme headwaters of the St. John's River. At ordinary times this area has from 1½ to 2 ft. of water over its surface, but during the rainy season the water is 4 to 5 ft. deep.

The whole country, north, west and south for from 20 to 50 miles is nearly a dead level, and during the rainy season the water stands on the prairies 2 to 4 ft. deep. For this season it will be necessary to surround the tract with a levee. The tract purchased is about one-third prairie and two-thirds sawgrass ponds, and is 6½ miles from the Indian River, famous for producing on its banks the best oranges in the State. The drainage will be into the San Sebastian River—a considerable stream emptying into the Indian River (which is a tidal lagoon).

The fall from the ordinary surface of the water in the swamp to tidewater in Indian River is 22 ft., and the length of the main canal will be 18 miles, and 54 ft. wide on the bottom, 8 ft. deep, with slopes of 2 to 1. The total length of the branch canals, including the boundary or intercepting canal, will be 95 miles, without counting the innumerable ditches. The levee will be 60 miles long and 30 ft. wide on top, 6 ft. high, slopes 2 to 1.

There are three large but shallow streams, some 600 to 800 ft. wide, now entering the tract from the west, which will be dyked out, and a new derivation channel dug for them. The "Great Sawgrass" lake, one mile north of the tract, will be 4 to 6 ft. above the water level in the tract, when lowered by the canals, and this will have to be kept out by levees and sheet piling. The slope of the main discharge canal will be such as to allow steomboat navigation, and this will be established from the Indian River to the lower St. John's by placing a lock in the canal to rise into the "Great Sawgrass" lake. A valuable water power of 232 H.P. will also be created.

The soil of these sawgrass ponds is a very rich black mud, 10 to 25 ft. deep. From the experience of the Disston Co., who have reclaimed and planted large tracts of this kind of land in the state, it is found to produce abundantly.

They have raised on similar land, without fertilizing of any kind, 6,000 lbs. of sugar per acre, 30 barrels of rice, worth $3.50 to $4 per barrel, 60 bushels of corn, and are now experimenting very successfully with tobacco.

The soil is peculiarly adapted for all kinds of garden vegetables, which can be placed in the northern markets in February and March. It is also exactly suited for bananas and other tropical fruits, and the drained prairie will raise pineapples, guavas, peaches, pears, mangoes, grapes, alligator pears, etc. The company is said to have strong financial backing, and are going right ahead.

WORLD'S FAIR NOTES.—The latest trouble in Chicago is a lack of space in several of the buildings as designed. The building for manufactures will be increased by roofing over the inner court provided. The plans for the government building will probably have to be changed. This structure was not to cost over $400,000; but the bids for it range from $410,500 to $775,000, not including the architects'

fees, superintendence, etc. The proposition of M. EIFFEL to build a tower has been rejected. It seems he only intended to prepare plans, leaving the responsibility for the foundations and erection with the Commission. At the same meeting three Chicago men offered to put up a tower 1,200 ft. high to cost $2,000,000. This proposition is being considered

FROM JAPAN TO NEW YORK IN 14 DAYS is the record made by the steamship *Empress of Japan* and the Canadian Pacific and N. Y. Central railways. The steamer left Yokohama on Aug. 19, reached Vancouver on Aug. 29, the exact time being 10 days 15 hours. The mail was transferred to a special train, and the run of 2,859 miles to Brockville, was made in 3 days 10 hours. The mail was then transferred to a special train at Morristown, N. Y., and the 353 miles to New York was made in 6 hours 58 minutes. Between Utica and Albany this special made 95 miles in 89 minutes. The run of 123 miles over the Rome, Watertown & Ogdensburg railway, a single track road with two bridges undergoing repairs, was made in 153 minutes, including three stops and twice slowing down for the bridges mentioned. The 143 miles from Albany to New York was covered in 141 minutes. The fastest time was made between Croton and Yonkers, 19 miles in 16 minutes, or about 71.4 miles per hour. The mail was transferred to the steamer *City of New York*, which will reach Liverpool on Sept. 9, just 21 days from Yokohama.

A FAST RUN was made on the Philadelphia & Reading R. R., Aug. 27. Between Neshaminy Falls and Langhorne, a distance of 2.8 miles, the highest speed was attained, a mile in 39½ sec., or at the rate of over 90 miles an hour. The fastest 5 miles were made in 3 min. 26½ sec., and the fastest 10 miles in 7 min. 12 sec., averaging 43 sec. per mile. The train was a special consisting of an eight-wheel express engine, with Wootten fire box and driving wheels 5 ft. 8 ins. diameter; 2 ordinary cars and the private car of Mr. MCLEOD, President of the road, the weight of which is said to be equal to 2 ordinary cars. This is the highest speed on record, the next being 86 miles per hour with a compound engine on the Northeastern Ry., of England, and 84 miles per hour on the New York, West Shore & Buffalo R. R.

BRICK MAKING MACHINERY is being taken up by the Kent & Essex Brickmakers' Association, England, and designs are invited for the making of sand molding bricks as now molded by hand in the various districts of the two counties, and usually designated stock bricks. The machine to be fixed, if practicable, at the mouth of the ordinary horizontal steam pug mills now in use, to be capable of making a brick quite equal to the present hand stock bricks, to turn out about 10,000 a day, and to be worked from the shafting at present in use at the fields. The three best designs that in the opinion of the association comply with the stipulations abovestated will receive an award of $60 each; should the association elect to adopt any of the designs submitted they will pay to the designer the sum of $625 for the purchase of all rights in such design, and the designer shall execute such deeds as the association may require for the assigning to them of the full right of such design. All designs to be sent to the office of the Kent & Essex Brickmasters' Association, Belvedere Road, Lambeth, London. Address the Secretary not later than Oct. 12.

THE NEWPORT STEEL CANTILEVER BRIDGE, a highway bridge connecting Cincinnati, O., and Newport, Ky., was officially opened to traffic on Aug. 29. This bridge crosses the Ohio River with 2 end truss spans of 252 ft. each, a channel cantilever structure with a central opening of 520 ft., and 2 truss spans of 254 ft. each. The approaches are made of plate girders and viaduct work of steel and masonry. There are 2 trusses of 108 ft. and 162 ft. in the Cincinnati approach. The total length of the bridge is 2,916 ft. The president of the bridge corporation is Capt. JOHN A. WILLIAMSON. The roadway is 24 ft. wide in the clear, with two 7 ft. sidewalks. The lower chord of the central span is 108 ft. above mean low water in the Ohio, and the steel towers on this span rise 85 ft. above the masonry and 190 ft. above the pier foundations. The bridge was designed for a moving load of 85 lbs. per square foot. The bridge was designed and constructed by the King Iron Bridge & Manufacturing Co., of Cleveland, O., on a contract for its complete construction, including the purchase of right of way in the two cities. This work was commenced in March, 1890. Messrs. Ferris, Kauffman & Co., of Pittsburg, Pa., were the engineers in charge of construction, and Messrs. A. H. PORTER, GEORGE E. GIFFORD and F. C. OSBORN are the engineers for the King Bridge Co.

LOCOMOTIVES OF THE TEN-WHEEL AND DECAPOD types for the New York, Lake Erie & Western R. R. are being built by the Baldwin Locomotive Works, of Philadelphia. One of the ten-wheel engines will be a four-cylinder compound on the Vauclain system, and will be given a thorough test in comparison with the simple engines. The decapod engines are for freight service and are to be built in November. The ten-wheel engines, which are for freight and passenger service, are being delivered, and the compound will probably be completed this month. The only difference between the simple and compound engines is that the latter will have cylinders 14 × 26 ins. and 24 × 26 ins., while the former have cylinders 21 × 26 ins. The engines are all fitted with the American and Westinghouse air brakes.

	Type of Engine.	
	Ten-Wheel.	Decapod.
Cylinders	21 × 26 ins.	24 × 28 ins.
Cyls. of comp'd	14 × 26 ins. and 24 × 26 "	
Diam. of driving wheels	62 "	50 "
Diam. of truck wheels	30 "	30 "
Diam. of boiler	66 "	76 "
Form of boiler	Wootten	Wootten.
Size of firebox	114 × 98 ins.	132 × 98 ins
Number and size of tubes	258 2 ins	350 2 ins.
Length of tubes	10 ft. 10 ins.	12 ft. 0 ins.
Heating surface	1,748 sq. ft.	abt. 2,500 sq. ft.
Grate area	77 "	89.8 "
Driving wheel base	12 ft. 0 ins.	19 ft. 2 ins.
Rigid wheel base	6 ft. 0 ins.	14 ft 2 ins.
Total wheel base	22 ft 10 ins.	27 ft. 3 ins.
Weight on driving wheels	105,850 lbs.	161,000 lbs.
Weight on truck wheels	28,100 lbs.	16,000 lbs.
Total weight	133,950 lbs.	177,000 lbs.
Weight of tender	85,000 lbs.	105,000 lbs.
Capacity of tender, water	3,600 galls.	4,500 galls.
Capacity of tender, coal	7 tons.	
Diam. of tender truck wheels	36 ins.	33 ins.

THE ENGINES OF THE U. S. ARMORED CRUISER MAINE were exhibited by the builders, Messrs. N. F. Palmer, Jr., & Co., to a large party of engineers and others, on Aug. 31. The engines were set up in the erecting shop of the Quintard Iron Works at 742 East 12th St., New York City, and were turned at a slow speed by a small launch engine connected by gearing to the propeller shaft. The engines are of the triple-expansion, vertical type, driving twin screws. The port and starboard engines are placed in separate water-tight compartments. The cylinder diameters are 35½ ins., 57 ins. and 88 ins., and the stroke is 36 ins. The total indicated HP. expected from the two engines is 9,000. Forged steel has been substituted for the cast steel specified in the original plans for rock shaft arms, forward coupling sleeve and the engine columns. An interesting detail of the valve gear is its interchangeability. All the cylinders have piston valves of the same diameter (22 ins.) there being one for the high pressure, two for the intermediate, and three for the low pressure cylinder. The engines when working at full power are to turn over at the rate of 132 revolutions per minute, giving a piston speed of 792 ft. per minute.

THE NEW YORK & NEW JERSEY BRIDGE CO., New Jersey contingent, elected, on Sept. 2, HENRY M. HAAR, president; JAMES T. SPARKMAN, vice president; DELOS E. CULVER, Chief Engineer and FREDERICK E. CULVER, Secretary. A committee on consideration was appointed to act with the New York company.

THE SOUTH FORK DAM INVESTIGATION by a committee of the American Society of Civil Engineers has been published in full in the *Transactions* of the society. This committee finds that the dam was originally thoroughly well built, and the original specifications of Mr. W. E. MORRIS, the engineer, provided for a spillway 150 ft. long and 10 ft. deep below the crest of the dam. This spillway was reduced to 70 ft. by 8 ft. deep by the Hunting and Fishing Club, the embankment was lowered 2 ft., the five sluices in the dam were removed in repairing it, and the spillway was further obstructed by gratings to prevent the escape of fish. The investigation into the rainfall that caused the Johnstown disaster shows that it was beyond question the heaviest since the construction of the dam. The surface of the water shed is quite steep, and the discharge was consequently rapid. Under the changes above pointed out, the spillway was not sufficiently wide to remove the water, and this rose, overflowed the crest of the dam and caused its collapse by washing down from the top. The ruins of the dam bore evidence to the good qualities of earthen embankments when fairly treated. The committee reporting was made up of Messrs. JAS. B. FRANCIS, W. E. WORTHEN, M. J. BECKER and A. FTELEY, three past presidents and one vice-president of the society.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Baltimore Belt.—The Belt Line R. R. Co. has increased its force at work on the tunnel and the approache, to 1,000 men. The dangerous quicksands encountered in the southern section of the tunnel have been nearly overcome, and the progress of work is now rapid. The stone abutments for the iron bridge by which the line will cross the Pennsylvania R. R. track in the northern part of the city are nearly finished. Above this bridge and across, North Ave. the city will soon begin the erection of a bridge, to cost $500,000. The grade of the new bridge will be from 12 to 15 ft. above that of the present structure to enable the Belt Line to cross the Pennsylvania tracks above grade, and at the same time pass under the North Ave. bridge. Encouraged by the progress made, the Bell Line contractors now expect to have the tunnel finished and the road ready to be operated in 2 years. The old Camden station of the Baltimore & Ohio R. R. will be enlarged and improved, and when the Belt Line is put in operation trains from New York and Philadelphia will pass directly under the city and into that station, thence on to the South and West. The Belt Line tunnel will cost $6,000,000.

Little Falls & Dolgeville.—Work has been resumed on the Dolgeville end of this New York railway, and it is stated that it will be rapidly finished. About 150 men are at work on the Little Falls end.

Bristol.—About 150 hands will soon be put at work on this route from Fairhaven Station to Bristol, Vt.

Cumberland Valley.—President F. B. Kennedy is reported as saying that his company would extend the South Pennsylvania R. R. from Richmond, Pa., its present terminus, to Fannettsburg, Pa., up Path Valley. Surveys are now in progress and work will begin at once.

Wild River Lumber Co.—Work is reported as making good progress upon this New Hampshire railway.

Glen Hazel & Shawmut.—Work on the first five miles of this road from Glen Hazel south is making good progress, all of the bridging and trestle work being finished. As soon as this section is finished work will be begun on a further extension of the road. The road will do a logging business principally. S. S. Bullis, Olean, N. Y., President.

Pennsylvania.—The contracts for the 7-mile extension from Pottsville to Minersville, Pa., have been let as follows; Wm. McAdams, 2 miles; John Dyer, Norristown, Pa., 2 miles; Joseph H. Gorman, Pottsville, Pa., 1 mile and A. J. Cushman, Philadelphia, Pa. The work is to be completed by December. It is probable that the line will be extended to Williamstown, Pa., next year.

Chicago & West Michigan.—J. J. McVean, of Grand Rapids, Mich., Chief Engineer, writes as follows:

Work on the Chicago & North Michigan R. R., from Traverse City, via Williamsburg, Bellaire, Central Lake and Charlevoix to Petoskey, Mich., 81 miles, with a branch from Williamsburg to Elk Rapids, nine miles, is making good progress, about 25% of the grading being completed and 10 miles of track laid. The maximum grade is 1% and the maximum curve is 4°. The principal business of the road will be in lumber manufactures and the summer passenger travel. It is expected to have the road open for traffic by July 1, 1892. The contractors are J. H. McLane & Co., of Traverse City, Mich., and the engineer in charge of work is H. F. Northrup.

Pittsburg, Ohio Valley & Cincinnati.—M. J. Becker, Chief Engineer, writes as follows:

The extension of this road from Bellaire to Powhattan, O., 18 miles, is now under contract and in process of construction. The grading is nearly completed and four miles of track, from Bellaire south, are laid. Between Powhattan and Marietta the line has been located but no work has been done nor will be for some time.

Projects and Surveys.

Westerly & Jewett City.—Frank H. Campbell, of Westerly, R. I., Clerk, writes us that this road is to run from Westerly, R. I., via Hopkinton, North Stonington, Voluntown and Griswold, Conn., to Jewett City, Conn., 38 miles. The preliminary surveys have been completed. The towns of Westerly and Hopkinton will probably guarantee the interest on $150,000 of bonds. Alex. B. Briggs, of Ashaway, R. I., is President, and Wm. G. Smith, of Waterbury, Conn., is Chief Engineer.

Milford & Mt. Vernon.—At a recent meeting of the incorporators of this Massachusetts railway the following officers were elected: President, W. G. Burnham, Mt Vernon; Treasurer, W. B. Rotch, Amherst; Clerk, F. E Kaley, Milford.

Cincinnati, Union City & Chicago.—Surveys have been commenced on this road, which is projected to run from Union City, Ind., via Portland and Bluffton to Huntington, Ind. It is stated that the contractors are making their estimates as fast as the line is located, and that work will be begun and finished as soon as possible.

Susquehanna.—Chartered in Pennsylvania to build a railway from Costello, Potter Co., Pa., to Hulls, Pa., on the East Fork of the Sounomahoning river, 14 miles. A. F. Goodyear, Austin, Pa., President.

SOUTHERN.—Existing Roads.

Nashville, Chattanooga & St. Louis.—This company is talking of building a line from Bon Air Coal Mine to Crossville, Tenn.

Nashville & Tellico.—An extension of this railway from Tellico Plains to Murphy, N. C., is being considered.

Genesis & Obed River.—Locating surveys are in progress for an extension of this railway from the Cincinnati Southern R. R. to Deer Lodge, Tenn.

Louisville & Nashville.—Tracklaying has been begun upon the belt line at Decatur, Ala. The Napier Branch of the Nashville, Florence & Sheffield R. R., running from Summertown to the Napier Iron Works, 12 miles, is completed, and will soon be opened for traffic.

Abbeville & Way Cross.—It is expected to have the extension of this Georgia railway completed from House Creek to Swan, Ga., by Oct. 1.

Charleston & Savannah.—This company is building an extension of the Ashley River R. R. along the Ashley River water-front at Charleston, S. C., to tap the phosphate manufactories in the vicinity.

Projects and Surveys.

Johnson City & Greensboro.—The survey for this proposed railway between Johnson City, Tenn., and Greensboro, N. C., is nearly completed.

Knoxvle, Monvale & Chilhowee.—This company has completed its organization by electing L. L. Hamilton, of Boston, Mass., President. Its proposed road is to run from Maryville, Tenn., on the Knoxville & Augusta R. R., to Monvale Springs and the mineral and timber lands of the Chilhowee Mountains. It is stated that the contracts have been let for building 10 miles of the line.

West Florida & Alabama.—N. A Butler, of Chipley, Fla., writes the *Manufacturers' Record* that this railway will run from Montgomery, Ala., via St. Andrews, Fla., to St. Joseph, Fla., and that work will begin in a few days. John B. Glenn, of Chipley, Fla., is at the head of the enterprise.

Chickamauga & Durham.—The Chickamauga Coal & Iron Co., of Chickamauga, Ga., will build a 17½-mile railway by this name.

Seaboard & Augusta.—Chartered in Georgia to build a railway from Augusta to some point on the Florida State line, near Tallahassee or Tampico, Fla. The incorporators are: T. C. Hogue, Jesse Thompson, F. B. Pope, C. E. Smith and G. E. Lyndon.

South Brunswick, Atlanta & Northwestern.—Incorporated in Georgia to build a railway from Wainesville to Fort Valley, Ga. The incorporators are: W. D. Wheelwright, 82 Wall St., New York City; J. A. Bloss, G. I. Dixon, Herbert Richmond and W. W. Waltin.

Georgia.—Bills to incorporate the Thomas & Lincolnton R. R. Co., the East & West R. R. Co., the Transvaal R. R. Co., the Tifton & Bainbridge R. R. Co., the Manchester & Atlantic R. R. Co., the Louisville Branch R. R., Co., the Boston & Albany R. R. Co., and the Brunswick, La Grange & Northwestern R. R. Co., have been introduced into the Georgia State Legislature.

Unaka & Nolachuckey.—R. A. Bowie, of Greenville, Tenn., Chief Engineer, writes as follows:

The surveys are nearly completed for the railway from Erwin, Tenn., via Embreville to Newport, Tenn., 55 miles, connecting the Charleston, Cincinnati & Chicago R. R. and the Western North Carolina R. R. The route is down the Nolachucky Valley, along the Unaka Mountains, paralleling the iron belt of East Tennessee. The work will be moderately heavy, with light grades and curves. There will be two bridges of 400 ft. and 600 ft. Nearly all of the right of way has been obtained and about $150,000 in town and county bonds secured. The principal business of the road will be in iron, timber and agricultural produce. Contracts for construction will be let about Nov. 1. A. S. Johnson is President.

NORTHWEST.—Existing Roads.

Superior, Red Wing & Southern.—The contract for building 10 miles of this railway from West Superior, Wis., to a connection with the Eastern Minnesota R. R., has been let to F. L. Johnson, of West Superior, Wis., and work is to begin within 60 days. From the junction south 37 miles the tracks of the Eastern Minnesota R. R. have been leased and from the end of this track to Red Wing, Minn., a new line will be built, contracts for which will probably be let in a few days. It is also probable that contracts for other work will be let soon. President, F. W. Hoyt, Red Wing, Minn.

Chicago & Northwestern.—An endeavor is being made to secure the construction of a branch of this railway from Chester Station to Waupun, Wis., about 3 miles.

Itasca Lumber Co.—The railway being built by this company from Grand Rapids, Minn., north, has been completed as far as Campton, Minn., about 20 miles. It is probable that the road will be extended further north next season.

Dakota, Wyoming & Missouri River.—Work is well started on this railway through the Black Hills mineral region. It is projected to run from Rapid City, S. Dak., west through the hills to Mystic, Wyo., where it will connect with the Burlington & Missouri River R. R., and thence to the Wyoming coal fields, a distance of 45 miles. The work is to be pushed as rapidly as possible, and the 30 miles to Mystic will be completed by Jan. 1, 1892, if the weather does not interfere. The contracts for construction have only been let for the first 10 miles as yet. It is also contemplated to construct a branch from the mouth of Prairie Creek to Hill City, S. Dak.

Kickapoo Valley & Northern.—At a recent meeting of the United States Construction Co., which has the contract for building this road, it was stated that all arrangements were completed to resume construction. It was decided to begin work at once and to have the line completed from Wauzeka to Soldier's Grove, Wis., 35 miles, by Nov. 1, and, if the weather permitted, to Viola, Wis., 50 miles. The road will ultimately run to Wilton, Wis., 80 miles from Wauzeka. E. J. Kidd, of Prairie du Chien, Wis., is President.

Southern Iowa.—This company has been organized in Iowa to build several branch lines of railway from Ottumwa, Ia., and vicinity to the various coal mines in Wapello Co. One branch about 3 miles long has already been completed. President, Paul Morton, Rookery Building, Chicago.

SOUTHWEST.—Existing Roads.

Velasco Terminal.—E. S. Dreyer, of Chicago, the contractor, has sublet the contract for building 22 miles of this railway to Burns, Burkett & Co. Work will begin at once, and the road built as rapidly as possible.

Texas Trunk.—It is stated that this railway running from Dallas to Cedar, Tex., 51 miles, will be extended, and that bonds have been marketed for that purpose.

New Orleans & Northwestern.—C. H. Hammond of Kansas City, Mo., and W. D. Jenkins, of Natchez, Miss. have been appointed joint receivers of this railway. The road, which was projected to run from Natchez, Miss., to Kansas City, Mo., 610 miles, was completed from Natchez to Rayville, La., 77 miles, last year, and partly graded 27 miles beyond Rayville. It is stated that the Receiver will complete the portion graded.

Projects and Surveys.

St. Louis, Malden & Memphis.—Chartered in Missouri to build a railway from Malden to Kennett, Mo., 23 miles. The incorporators are: C. L. Hawkins, John Taylor, W. H. Penny, G. W. Peck, G. D. Vanclive, Wm. Bridges, H. P. Kasolening, H. N. Phillips, M. W. Hubbard and J. M. Wattriffs.

New Orleans Belt.—The Citizens' Public Belt R. R. Association has issued a prospectus of the proposed belt railway at this place. Under the plan proposed one-half of the net profits go to the city as an improvement fund, and the balance of the profits, with 6% interest on their investment, is to go to the stockholders. The cost of the work is estimated to be from $700,000 to $800,000.

Trinity, Cameron & Western.—This company was recently organized in Texas with J. M. Hefly as President, and M. J. Moore as Secretary. It proposes to build a railway from Trinity to Granger, Tex., about 113 miles. Surveys will begin at once.

ROCKY MT. AND PACIFIC.—Existing Roads.

Great Northern.—Tracklaying on the Seattle & Montana R. R., which has been delayed on account of lack of material, is now being rapidly pushed, and the road will probably be in operation in the course of a few weeks.—— A letter from V. G. Bogue, formerly Chief Engineer of the Union Pacific Ry., published in a Tacoma, Wash., paper, states that the Great Northern and Union Pacific companies have adjusted matters relating to the construction of the Portland Seattle extension, but that the work will not be resumed until the condition of the money market is more favorable for the marketing of the company's securities.

Northern Pacific.—About 150 men and 60 teams are at work on the South Bend end of the Chehalis-South Bend Branch of this road. Eighteen miles of the grading have been completed and 10 miles more will soon be under way. Only 15 miles more remain to be put under construction.

Projects and Surveys.

Pacific & Eastern.—This company has been chartered in Oregon by Frank S. Taylor, M. J. Kinney and H. G. Vandusen, with principal office at Astoria. The capital stock is $10,000,000. The object of the company is to build a railway south from Astoria to and up the Tillamook river, across the Coast range to the headwaters of the Yamhill river, and down the said river to the east side Coast mountains; thence south through the Willamette valley to Springfield; thence easterly crossing the Cascades by way of the Middle Fork of the Willamette to East Cascades; thence easterly by way of Harney lake valley and Eastern Oregon and through Southern Idaho to Salt Lake City, Utah. It also proposes to build a line from Astoria to Portland; thence south through the Willamette valley to a practicable connection with the main line.

East Oregon.—The preliminary survey for this railway from Heppner, Ore., to Greenhorn, Ore., with a branch from Pendleton to coal mines, has been begun.

FOREIGN.

Apam & Tuxpam.—A company is to be formed to build a railway from Apam to Tuxpam, Mexico. Gen Rosendo Marqueg, Governor of the State of Pueblo, is interested.

Mexican Northwestern.—Six kilometers of rails have been laid on this railway from Chihuahua west.

Chiopas.—It is stated that a railway will be built from the Chiopas company's mines to the Teapa River, 25 kilos.

Tehuantepec.—The *Mexican Financier* says:

Work has stopped on the National Tehuantepec Ry., but it is hoped that arrangements will be made whereby construction will soon be recommenced and carried forward rapidly until the completion of this important national railway of great significance to the commercial interests of Mexico.

Costa Rica.—A press dispatch from Panama says:

The contract entered into by the Government of Costa Rica, on June 10, with the Costa Rica Syndicate (Limited) for the construction of a railroad to the Pacific, has been approved by the Constitutional Congress. The Government guarantees the company a minimum profit of 5% per annum during a period of 25 years on the total cost of the new line, which has been estimated at £800,000.

CITY TRANSIT.

Electric Railways.—New lines or extensions of existing systems are probable in the following places: Amherstburg, Ont.; Elk City, W. Va., address the Charleston Street Ry. Co., Charleston, W. Va.; Searcy, Ark.; Paris, Ky., address D. Turney; Pittsburgh, Pa., address the Pittsburgh Traction Co., Kensington, Pa.; Berkeley, Cal. address W. C. Upton.

Rochester, N. Y.—It is reported that complete right of way has been secured for a passenger and freight line from this city to Fairport. L. J. Delano, of Fairport, is understood to be at the head of the project.

Rome, Ga.—The East and West Rome Street R. R. Co. has, it is said, decided to adopt electricity as a motive power; the estimated cost of the improvement is $60,000.

Tampa, Fla.—Capt. Frazier, of Chattanooga, Tenn., will, it is said, build a line from Tampa to Frazier's Beach, a distance of 4 miles.

Springfield, Ill.—The City Ry. Co. will improve its track and lay 60-lb. rails on a number of streets where those now used are too light for electric cars.

Chattanooga, Tenn.—The Chattanooga Water and Electric Co. has issued $50,000 of bonds for the purpose of constructing its railway to the top of Cameron Hill.

Sherman City, Tex.—It is reported that the street railway here will be extended 3 miles and be operated by electricity.

Ione, Cal.—Surveyors are at work on the line of the proposed railway to Sutter Creek. Two different routes will be surveyed before the location is made.

Oakland, Cal.—The electric road from this place to Haywards will follow the county highway from San Leandro to Haywards, it being found impossible to secure right of way on the old railway embankment which was at first proposed.

Stockton, Cal.—According to the Stockton *Independent* the San Francisco syndicate has bought the street railroad here and will rebuild and extend the track and introduce electricity.

Horse Railways.—New lines or extensions are reported as probable in the following places: Manchester, Va.; East Lake, Ala., address the Lake Superior Land Co.; Stephenville Tex., address J. Collins; Greencastle, Ind., address F. G. Gilmore.

Kingsland, Ark.—A tram road will be built from this place south to the Ouachita River by S. A. Graves, W. H. Starr, and others.

Cable Railway—***Baltimore, Md.***—E. D. Smith & Son report that work will probably begin on the new lines of the Baltimore Traction Co. within 5 weeks.

New Companies.—Madison & Eatonton Dummy Line Co., Madison, Ga.; capital stock, $25,000; incorporators, J. H. Holland, T. P. Gibb and others. Bartow (Fla.) Railway & Improvement Co.; capital stock, $5,000; President, Frank Clark; Secretary, W. F. Way. Chicago (Ill.) South Shore Ry. Co.; capital stock, $500,000; incorporators, J. R. Mann, F. I. Bennett, C. F. White and others. Interstate R. R. Co., Attleboro, Mass.; capital stock, $50,000; already chartered in Rhode Island to do business in Providence, Pawtucket, Central Falls, East Providence, Lonsdale, Attleboro, Seekonk and North Attleboro. West & South Towns' Horse Ry. Co., Chicago, Ill.; capital stock, $100,000; incorporators, C. L., L. C. and M. A. Bonney. Orange Mountain Cable Co., Newark, N. J.; capital stock, $350,000; incorporators, Geo. Spotiswood and S. D. Day, of Orange; H. L. Chandler, of Philadelphia, and others.

BRIDGES, TUNNELS AND CANALS.

Bridges.—***Bergen Co., N. J.***—Bids will be received until Sept. 8 for building a bridge between the counties of Bergen and Passaic. Jas. Carroll, 10 Ramapo Ave., Paterson, N. J.

Blythesdale, Pa.—The Douglass Bridge Co., of Blythesdale, Pa., has been chartered by Jas. E. Douglass, of Allegheny, Pa., and others, to build a bridge connecting Suterville and Blythesdale, Pa.

Pittsburg, Pa.—The War Department has approved the plans of the Upper Bridge Co., of Pittsburg, Pa., for its proposed bridge across the Monongahela River. The bridge will be 53 ft. high and 370 ft. long.

Red Sulphur Springs, W. Va.—The Monroe County Court has appropriated the money necessary for building an iron bridge across Indian Creek. Monroe County Clerk, Union, W. Va.

Winona, Minn.—The Chicago Bridge & Iron Co., of Chicago, has the contract for building the wagon bridge across the Mississippi River at this point. The bridge will have one 360-ft. span, one 200-ft. span and two 250-ft. spans. There will be a wooden trestle approach on the Wisconsin side and an iron approach on the Minnesota side. The contract price is $94,700.

Brazoria, Tex.—Bids will be received until Sept. 11 for building an iron bridge over the Bernard River. The river is 232 ft. wide. A. R. Masterson, Brazoria, Tex.

Vernon, Tex.—There is talk of building an iron and steel bridge over the Peace River at this place.

Canals.—The Suwannee Canal Co. will soon commence construction of its canal from the Okefenokee Swamp to the St. Mary's River.

HIGHWAYS.

Massachusetts.—Boston is building a macadam road from Mt. Hope to the Hyde Park line, with 18 ins. of broken stone.

New York.—The town boards of Dunkirk and Sheridan have decided upon the construction of a new road between these towns.

New Jersey.—The Middlesex Co. Board of Freeholders is considering the question of constructing a system of macadamized roads, similar to that of Union Co.

Pennsylvania.—A movement is on foot to repair that part of the old Robbstown and Somerset turnpike road lying between Mt. Pleasant and Jones' Mill. A number of citizens of Mt. Pleasant and along the route of the road are interested in the movement, among them O. P. Shupe, Isaac Horner and Samuel Cummings. The company expects to begin work within two or three weeks, and it is estimated that about $14,000 will be required to put the road in a proper state of repair. Toll gates will then be re-established on the road.

Colorado.—The Jefferson Co. Commissioners, at a meeting at Golden, decided to build a new road along Bear Creek, above high water mark, so that there will be no more damage from floods. The road will run from Morrison to Idelldale, 6 miles, and will have 4 bridges.

WATER-WORKS.

NEW ENGLAND.

Pittsfield, Me.—The town meeting has accepted the report of the committee appointed to consider the water-works question, giving estimates of cost, etc. A motion to purchase the franchise and property of the Pittsfield Water Co. was lost.

South Berwick, Me.—A proposition has been made to the selectmen to furnish a water supply from Warren's pond.

Lee, Mass.—The Berkshire Water Co. proposes to build another reservoir, the present one not being sufficient in case of drought.

Bridgewater, Mass.—The question of additional water supply is being agitated.

Kingston, Mass.—At a town meeting J. L. Hall and P. W. Maglathlin were appointed a committee to make investigations as to the available sources for an additional supply. Jones river is considered a probable source.

Arlington, Mass.—The work of connecting the mains of the Braintree and Weymouth water-works has been completed.

MIDDLE.

Brooklyn, N. Y.—The contracts for the new main from the Ridgewood reservoir to the lower part of the city have been let to Cranford & Valentine for the first section and John McNamee for the second.

Newtown, N. Y.—A petition for a water-works franchise has been made by C. S. Huntley, of Buffalo; Joseph Meyerose, of Newtown; and J. H. Seely, J. J. Livingston and Henry Kahlert, of Brooklyn. It is proposed to lay 100 hydrants for $7,500, the next 100 for $5,000, and others at $3.500 per 100.

Yonkers, N. Y.—The Board of Water Commissioners has awarded the contract for a new water-tower on Nodine Hill to P. J. Flannery, at $18,300.

Holland, N. Y.—Work has been commenced on the water-works.

Waterford, N. Y.—The Waterford Water Co. is laying a new suction main to the Hudson River. The pipe will be laid in a trench in the rock bottom, and the inlet will be in 12 ft. of water.

Dryden, N. Y.—Surveys for a water-works system are being made by L. O. Howe.

Union, N. Y.—The Union Water Co. has been organized by S. H. Morgan, Fred C. Reynolds, A. A. Morgan, and others. Capital stock, $25,000.

Dansville, N. Y.—It is proposed to establish a system of water works for domestic supply, or to grant a franchise for such a system.

Hyndman, Pa.—The Hyndman Water Co. has $10,000 of its capital stock paid in, and not $100, as accidentally stated last week, owing to a typographical error.

Lancaster, Pa.—The Water Committee of the Council has engaged Mr. Samuel M. Gray, M. Am. Soc. C. E., of Providence, R. I., to report on the desirability of building a new reservoir of 15,000,000 to 20,000,000 galls. capacity, to be used in connection with the present pumping plant.

McKeesport, Pa.—The Water and Lighting Committee has instructed Superintendent Ecoff to prepare plans and specifications for two pumps of 3,000,000 galls. daily capacity.

Mansfield, Pa.—A franchise for the Mansfield Water Co. will probably be granted this month to Ammerman & Waters, of Scranton. The contract with the borough is ready to be signed as soon as the franchise is granted. The borough will take 40 fire hydrants, and the Normal School will pay $1,000 per year. The line will be about 7½ miles long.

SOUTHERN.

Wytheville, Va.—The Town Council has purchased Venricles spring, on Lick mountain, 3 miles from the city. A reservoir is being built near the spring, from which a pipe will be laid to the town reservoir.

Fairmont, W. Va.—The mayor and engineer have been visiting the Wheeling water-works, to obtain points in regard to the proposed works for Fairmont.

Cleveland, Tenn.—The contractors for the new works are said to be Sturtevant Bros. Information can be obtained of J. H. Hardwick.

Mayfield, Ky.—Water-works are to be established. The supply will be obtained from wells.

Franklin, Ky.—The new works will be built next spring, according to report.

Ashland, Ky.—The reservoir of the Ashland Water Supply Co., which was illustrated in our issue of April 11, has been completed at a total cost of $20,375.

Savannah, Ga.—The contract for 36 and 42-in. iron pipe has been awarded to Howard Harrison & Co., of Bessemer, Ala., at $21.25 per ton, and 2¾ cts. for specials. The contract for 6 ft. masonry conduit, 3,664 ft. long, has been let to Robertson & Weaver, of Baltimore, Md., at $44.175. The Holly Co. has the contract for engines.

Monroe, La.—It is proposed to levy a tax for a system of water works.

Lake Charles, La.—Plant for water works is wanted by J. A. Landry & Co., including pumps of 500,000 galls. daily capacity, stand-pipe about 16 × 125 ft., and 6, 8 and 10-in. cast-iron pipe.

NORTH CENTRAL.

Niles, O.—A pumping test of the wells has been made. It is said they will supply 800,000 galls. per day.

Norwalk, O.—The Council has employed Mr. C. A. Judson, City Engineer of Sandusky, to make plans and estimates for the proposed water works.

Lafayette, Ind.—A system of wells is being put down in the river for the water to filter through the gravel to a caisson in the river, from which the water will be pumped to a reservoir. This is in addition to the present works. The work is being done by the National Water Supply Co., of Cincinnati, O., and will cost $18,000.

Mason, Mich.—The Board of Water Commissioners will receive proposals Sept. 10 for furnishing material and labor and building a system of water-works. Brick building and stack. 2 compound condensing pump engines, 2 boilers 5 ft. by 14 ft., 75 double-nozzle hydrants, about 50 valves, about 7 miles of 4 to 12 in. cast-iron pipe and pipe laying. W. S. Parker, Consulting Engineer.

Saginaw, Mich.—A supplemental report on the water-works on both sides of the river is being made by Mr. J. D. Cook, of Toledo, O.

Jackson, Mich.—The vote on the issue of bonds for $100,000 for water-works will be taken Sept. 14.

Bay City, Mich.—The Water Board has awarded the contract for pipe and specials to the Addyston Pipe & Steel Co., of Cincinnati, O., at $20.75 and $39.80 per ton respectively.

St. Joseph, Mich.—A vote will be taken on a proposition to issue bonds for water-works.

Lincoln, Ill.—The contract for laying 4 miles of additional mains has been awarded to Coogan & Hagen, of Lincoln.

NORTHWESTERN.

Des Moines, Ia.—A contract has been let for 50 hydrants at $32.50 each.

Tekamah, Neb.—Work has been commenced on the water-works.

Belle Fourche, So. Dak.—It is reported that a system of water-works is to be established.

Vermillion, So. Dak.—The contract awarded by the Vermillion Artesian Well, Electric Light, Mining, Industrial & Improvement Co. to the Michigan Pipe Co., of Bay City, Mich., calls for 17,390 ft. of 4-in., 4,730 ft. of 6-in and 1,200 ft. of 8 in. pipe, 50 hydrants, 27 valves and boxes, 2 duplex non-compound engines, 2 boilers 5 × 14 ft. and a tank 16 × 24 ft., 80 ft. high.

SOUTHWESTERN.

Brookfield, Mo.—The vote on the proposition to issue bonds for $25,000 for water-works resulted in a majority of 603 in favor of the proposition.

Kansas City, Mo.—A board of examining engineers is investigating the water-works. The board consists of M. L. Holman, Water Commissioner of St. Louis; G. H. Bengenberg, City Engineer of Milwaukee, Wis.; and Charles Hermany, Superintendent of Water-Works, Louisville, Ky. They are to consider the location and design of an entire new plant.

McGregor, Tex.—The McGregor Artesian Water Co. is said to have been awarded a contract for water-works.

Dallas, Tex.—The city will invite proposals for a pumping engine of 10,000,000 galls. capacity.

PACIFIC.

Albina, Ore.—A system of cisterns with a capacity of 40,000 galls., each is being established for fire protection.

Tacoma, Wash.—A water-works committee has been appointed to consider the questions of sources of supply, feasibility of different systems, estimates of cost, etc. The committee will engage engineers. The committee has adopted a resolution to the effect that at as early a date as practicable the city should own its water-works.

South Bend, Wash.—The South Bend Water Co. has been incorporated. E. H. K. Owen, E. Shepard, and A. V. Boullion. Capital stock, 100,000.

Montesano, Wash.—The city will issue bonds for $18,000 for a water supply pumped from lake and creek to reservoir. The present supply is from wells. Contracts will be let about Oct. 1. For particulars address H. R. Ballamy.

Los Gatos, Cal.—The Mountain Spring Water Co. has been incorporated by Roscoe Bear, R. P. Grader and T. E. Beckwith. Capital stock, $100,000.

Sacramento, Cal.—The question of obtaining a better and more adequate water supply is under discussion.

Los Angeles, Cal.—The proposition to put in a new water-works plant at a cost of $250,000 is to be considered.

CANADA

Sandwich, Ont.—The vote on water-works has resulted in 108 for to 12 against the proposition. Construction will soon be commenced.

ARTESIAN WELLS.

Darby, Pa.—A well is being bored on New St.

Charleston, S. C.—The Charleston Water Co. will bore a new well.

Alexandria, La.—The City Council has signed contracts for two artesian wells, which are to furnish a supply of 100,000 galls. per day. The cost will be $2,250 each.

Eaglewood, Tex.—It is stated that wells are to be driven to supply water for this new town, near Hitchcock.

Marlin, Tex.—The artesian well is down 1,585 ft. and is now in limestone.

IRRIGATION.

Colorado.—Mr. Maxwell, State Engineer, has located sites for 3 reservoirs, one near Buena Vista, one near Monument, El Paso Co., and one in Hardscrabble Co., Custer Co. Mr. W. A. Watson, of Wetmore, is interested in the latter.

California.—It is reported from Sacramento that a very large reservoir is to be constructed in Penn Valley. C. F. Ayer, the principal owner of the Excelsior Water Co.'s rights and lands, is said to be at the head of the enterprise, which has for its object the irrigation of practically all the lower foot-hills and plains between Penn Valley and Marysville.

Tulare, Cal.—A syndicate composed of James Morton, J. N. Wright, J. H. Hurd and John Tuoby, is said to have organized a syndicate to build a flume 30 miles long for irrigation and for carrying lumber.

Galt, Cal.—The Galt Irrigation Co. expects to have a ditch and irrigation work completed in the eastern part of the county within a year. President, J. A. Ellison; Secretary, James Field.

California & Oregon.—The Ashland (Ore.) *Tidings* says that the irrigation enterprises in Northern California and Southern Oregon are taking shape in projects of some size. Besides the big canal which has been surveyed to take water from the Klamath River, in Klamath Co., Ore., and place it where it is needed for irrigation, on the plains of Shasta Valley, in Siskiyou Co., Cal., a big canal has been surveyed by the Carr Canal & Irrigation Co., of Klamath Co., to cover all the arable country on the eastern side of Tule Lake, extending into Modoc Co., Cal. The proposed canal will be 25 ft. wide and 28½ miles long, and a claim for 50,000 miner's inches of water for it has been recorded in Klamath and Siskiyou counties.

SEWERAGE AND MUNICIPAL.

Sewers.—*Massachusetts.*—Wakefield. A sewerage system is said to be needed.—Palmer. Mr. J. J. Van Valkenburg has recommended the separate system with filtration.

Connecticut.—Willimantic. A sewer contract has been awarded to A. Brazos, of Middleton, at $2,871.—South Manchester. The sewerage system designed and being constructed by Mr. T. H. McKenzie, of Southington, has 3 siphons in the main sewer, 800, 1,000 and 1,800 ft. long.

New York.—Glens Falls. A report on the proposed sewerage system has been made by Mr. S. E. Babcock. The cost is estimated at $167,665.

New Jersey.—Weehawken. A sewerage system is

needed.—Paterson. The new east and south sides sewer will be of brick, with 1,100 ft. of 8 ft. diameter, 2,400 ft. of 7 ft., 3,600 ft. of 6 ft., 4,400 ft. of 5 ft. and 2,600 ft. of 4 ft.; 70 manholes and 30 basins.—Newark. The Sewer and Water Board has approved the report of its committee on the failure of the $900,000 intercepting flume. The blame is laid upon the use of lighter timbers than specified, and of iron nails and spikes instead of trenails.

Maryland.—Baltimore. Extensive improvements are being made in the sewer system.

District of Columbia.—Washington. The contract for sewer construction under the appropriation for 1892 has been awarded to E. E. Barnes.

Alabama.—Birmingham. Contracts have been awarded for the construction of sewers on the south side An engineer will be engaged to prepare plans and specifications for a complete system for the city, including the town of Highlands.

Indiana.—Warsaw. The Warsaw Sewerage & Drainage Co. has a franchise under which it builds sewers and extends them as people order connections made. The city pays a certain sum for the use of the sewer for surface drainage.

Michigan.—Detroit. An enabling act passed by the last Legislature permits the city to raise $1,000,000 by bonds for constructing sewers; but provides that only $500,000 shall be raised at one time, and this only upon a vote of the people at a charter election. A vote is to be taken shortly.

California.—San Francisco. A sewerage system for the southern district of the city is proposed. It is recommended that the city should adopt a plan for a complete system, and build the part for each district in accordance with that plan.

Streets.—*Pennsylvania.*—Norristown. The contract for paving Main St. has been awarded to W. S. Smith, for 3,600 sq. yds. at $2.45. The asphaltum blocks will be furnished by the International Block Co., of Baltimore, Md.

District of Columbia.—Washington. The pavement on B St. is to be relaid, and 20 ft. on each side will be paved with brick.

Florida.—Orlando. It is proposed to issue bonds for $15,000 for street paving.

Michigan.—Detroit. The Board of Public Works will have Champlain St. paved with brick.

Bonds.—Meridan, Miss.; $75,000 for sewers and streets. Detroit, Mich.; $500,000 for sewers. Indianapolis, Ind.; $25,000.

ELECTRICAL.

Electric Light.—New plants or extensions of existing stations are reported as probable in the following places: Nashville, Tenn., address the Citizens' Rapid Transit Co.; Seymour, Ind., address W. H. Shields; New Castle, Pa., address the New Castle Electric Light Co.; Cordele, Ga., address E. J. Williams; Brenham, Tex., address W. W F. Boyle; Franklin, Ky., address M. S. Harris.

Braintree, Mass.—At a recent town meeting, the act of the Legislature to establish their own system of electric lighting was accepted by a vote of 149 to 3. The committee appointed at the last town meeting to investigate the different systems reported in favor of the arc system, and recommended the establishment of a plant at a cost of $20,000, running 100 arc lights, at a cost of about $50 each per year.

Yorkville, S. C.—A. M. Grist (care *Enquirer*) will buy an incandescent plant of 30 lamps capacity.

Circleville, O.—The Pickaway Electric Co. has contracted to furnish 110 arc lights of 2,000 c. p. at $75 each a year, the contract to run for 10 years.

Noblesville, Ind.—J. L. Peck has received a contract for 3 years for furnishing 25 lights of 2,000 CP. at $87.50 per light per year, the all-night schedule to be used.

Alton, Ill.—The directors of the Alton Gas & Electric Co. have increased its capital stock from $40,000 to $60,000, and have decided on improvements costing about $15,000.

Kansas City, Mo.—The secretary of the Board of Public Works will receive bids for city lighting by gas, gasoline or electricity until Sept. 11.

New Companies.—Newnan Light & Power Co., Newnan, Ga.; capital stock, $15,000; incorporators, W. L. Dresser, of Albany, N. Y.; W. S. Whitham, of Anniston, Ala., and others. Waterloo Electric Light & Power Co., East St. Louis, Ill.; capital stock, $10,000; incorporators, W. Wurdack, R. M. Hammon, M. A. Waters. Circleville Light & Power Co., Circleville, O.; capital stock, $100,000. Wright & Starr Electric Co., Philadelphia, Pa.; capital stock, $250,000; incorporators, B. F. Morley, of Chester; E. E. Wright, of Philadelphia, and others. Red Oak Electric Co., Red Oak, Ia.; capital stock, $25,000; incorporator, W. H. Blood, of Kansas City.

CONTRACTING.

Street Work.—*Norristown, Pa.*—Proposals for paving have been received by the Streets and Road Committee. Mr. M. D. Patterson is Borough Engineer. The street is to be paved the entire width with asphaltum blocks resting on a 7-in. bed of concrete, with the exception of the gutters and the space between and 1 ft. on each side of the street railway tracks, which will be paved with stone blocks; the stone blocks between the tracks will rest on a bed of sand. R. A. Woodbury & Co., Wilmington, Del.: asphaltum pavement, $2.86 per sq. yd.: granite blocks, $3.34 for sample No. 1, $2.99 for No. 2 with concrete; $2.61 and $2.34 on sand. Wm. G. Smith, Norristown: paving complete, including asphaltum and stone blocks, $2.45 per sq. yd. Geo. H. Filbert, Philadelphia, Pa.: $3.12. E. G. Smede, Norristown: $2.87 with concrete of cinder or furnace slag, $3 with concrete of hard stone. Murray & Moore, Philadelphia, Pa.: $2.75. A. N. Carson, Norristown: $3.50 or $3.55 with concrete of furnace slag or stone. The contract has been awarded to Wm. G. Smith.

Washington, D. C.—The following proposals for granolithic paving and curbing have been received by Col. O H. Ernst, U. S.A., Office of Public Buildings and Grounds: H. L. Cranford, Washington, $2.70 per sq. yd. for paving and $1 per lin. ft. for curbing. Schillinger Paving Co., Washington, $2.45½ and 34cts.

Water-Works.—*Brooklyn, N. Y.*—Contracts have been let for the new main from Ridgewood reservoir: section 1, Cranford & Valentine; section 2, John McNamee. The prices, including repaving and removing surplus dirt on city streets, are as follows: $5.25 per ft. for 48-in. main, $3.25 for 36-in., $3 for 30-in., $1.20 for 20-in, 60 cts. for 12-in., $12 per cu. yd. for brick masonry, $9 for rubble masonry, $7 for concrete.

Sewers.—*Corry, Pa.*—Proposals heve been received for the construction of a 48-in. trunk sewer according to plans and specifications prepared by Wilson & Smith, of Saltsburgh, Pa., and Mr. R. H. Wilson of that firm has been appointed engineer in charge of construction. The contract has been awarded to W. J. Dunn, of Allegheny, Pa. Work will be commenced soon and is to be completed by September, 1892. It will include 5,700 ft. of brick sewer, 2,700 ft. of cast iron pipe sewer, 20 brick manholes, 6 iron manholes, 14 lampholes, 23 lateral junctions and 560 house connections.

	48-in. sewer, per lin. ft.		Manholes, each.		Catch basins and inlets, each.	Lamp holes, each.	Lateral sewer junctions.	House branches.	Concrete, per cu. yd.	Lumber, per M B. M.
	Brick.	Cast iron.	Brick.	Iron.						
Love Bros., Corry, Pa.	.....	$8.20	.....	$40.00	Tile, $85.00 Iron, 105.00	$15.00	.....	$2.00	.....	.....
McCarthy & Sager, Cleveland, O.	$6.64	18.75 to $47.00 / 63.00	.....	.....	to 73.00 / 127.00	18.83	$2.44	to 2.00 / .23	$4.00	$15.00
W. J. Dunn, Allegheny, Pa.	5.95	* to 9.85 / 12.00	35.00	.....	80.00	10.00	1.50	.50	4.00	15.00
J. H. Harlow & Co., Pittsburg, Pa.	6.49	10.47	53.00	2½c. per lb.	85.00	17.00	5.00	.35	to 6.00 / 7.50	25.00
McMahon Bros., Rochester, N. Y.	7.24	9.70	.....	.....	Complete.		.....	.....	.....	.....
Lambing, Corcoran & Connell, Pittsburg, Pa.	7.00	10.24	.....	.....	Complete.		.....	.....	.....	.....
J. H. McQuade, Pittsburg, Pa.	9.65	* to 10.25 / 11.75	40.00	.....	95.00	4.00	2.25	.75	4.00	15.00
Condon & Curley, Jersey City, N. J.	5.73	9.87	.....	.....	Complete.		.....	.....	.....	.....

*According to weight of pipe.

Cement.—Proposals have been received by Col. S. M Mansfield, U. S. Engineer Office, Boston, Mass., for 7,000 bbls. of American hydraulic cement at Fort Warren, Mass., and 9,000 bbls. of the same at Bennett's wharf, Boston harbor. T. W. Carter, Boston, $1.03 and 1.07 per bbl., respectively; W. G. Nash, Boston, $1.02 and $1.05; E. S. Kent, Boston, $1 and $1.03; Waldo Bros., Boston, $1.01 and $1.03; H. Fleming, New York, N. Y., $1.06 and $1.09½.

Pipe.—*Bay City, Mich.*—The Water Board has awarded a contract to the Addyston Pipe & Steel Co., of Cincinnati, O., at $20.75 per ton for cast iron pipe and $39.80 per ton for special castings.

Savannah, Ga.—The contract for pipe and specials for the water-works has been awarded to Howard, Harrison & Co., of Bessemer, Ala., at $21.75 per ton for 36 and 42-in. pipe, and 2¾ cts. per lb. for special castings.

PROPOSALS OPEN.

Dredging.—*Toledo, O.*—In Maumee River. C. H Duncan, City Clerk. Sept. 10.

Sewer.—*Newark, N. J.*—On South Canal St., 820 ft. of 18-in. salt glazed pipe, four manholes, one basin. Board of Street and Water Commissioners. Sept. 8.

Street Work.—*Baltimore, Md.*—Granite curbing, 6-in. A. E. Smyrk, City Commissioner. Sept. 9.

Wilmington, Del.—Vitrified firebrick paving. Street and Sewer Department. Sept. 10.

St. Louis, Mo.—Sidewalks round U. S. Custom House. C. K. Ramsey, Superintendent. Sept. 15.

Water-Works.—*Mason, Mich.*—Brick building and stack, two compound condensing pumping engines two boilers 5 × 14 ft., stand-pipe 15 × 100 ft., 75 double-nozzle hydrants, 50 valves, seven miles of 4 to 12-in cast-iron pipe and laying. Board of Water Commissioners. Sept. 10.

Bridges.—*Braxoria, Tex.*—Iron swing or draw bridge over Bernard River, three miles from city; river 232 ft. wide 14½ ft. deep, bank 9 ft. perpendicular, approaches 30 and 47 ft. A. R. Masterson, County Judge. Sept. 11.

Stone.—Cut stone at Wetumpka, Ala. Capt. P. M. Price, U. S. Engineer Office, Montgomery, Ala. Oct. 3.

Baltimore, Md.—Crushed stone on the Falls Road. A. E. Smyrk, City Commissioner. Sept. 10.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Richmond Locomotive & Machine Works, of Richmond, Va., have built 21 engines and rebuilt 5 this year. The works have a capacity of 100 engines per year. The Brooks Locomotive Works, of Dunkirk, N. Y., have built a compound engine for the Lake Shore & Michigan Southern, cylinders 17 and 28 × 24 ins. The Pennsylvania is building a heavy passenger engine at its Altoona works.

Cars.—The Laconia Car Works, of Laconia, N. H., have completed 4 passenger cars for the Maine Central; they have gates to the platforms. The Missouri Car Co., of St. Louis, Mo., has orders for 400 box, 200 gondola and 150 platform cars for the Wisconsin Central. The St. Charles Car Co., of St. Charles, Mo., is building box and gondola cars for the Texas & Pacific. The Southern Pacific is building 400 box and flat cars at its Sacramento shops and has let contracts for 300 box and 100 furniture cars. The Huntington & Broad Top Mountain has let a contract for 150 hopper gondola coal cars of 60,000 lbs. capacity.

Road Roller.—The Watson Iron Co., of Paterson, N. J., has furnished a 4,000-lb. two-horse roller to the Street Committee of Middletown, N. Y.

Companies.—Northwestern Sewer Pipe & Tile Co., of Riverside, Ia.; manager, D. A. Jackson. Combination Car Co., of Portland, Me.; president, D. W. Scribner; $100,000. Mills Improved Pneumatic Brake Co., of Chicago, Ill.; W. B. Mills and O. A. Bogue; $600,000. Standard Nut Lock Co., of Newark, N. J.; A. N. Ake, W. W. Blanchard and E. Harrison; $100,000. Standard Railway Gate Co.; president, G. A. Reynolds. Utica, N. Y.; $300,000. Minneapolis Malleable Iron Co., of Minneapolis, Minn.; president, G. W. Walker; $50,000. Automatic Car Journal Lubricator Co., of Chicago, Ill.; J. B. Keogh, Robert Kendal and R. J. McIntyre; $1,000,000. Ludlow Valve Mfg. Co., of Montclair, N. J.; J. T. Christie, of Troy, N. Y.; M. Nathan, David Callahan and G. H. Starr, of New York; and T. M. Wheeler, of Montclair; $700,000.

Metal Market Prices.—*Rails.*—New York: $30.75 to $31; old rails, $21.50 for iron and $17 for steel. Pittsburg: $30; old rails, $23.50 to $24 for iron and $17.50 for steel. Chicago: $31.50 to $32; old rails, $22.50 to $23 for iron and $14 to $16 for steel.

Track Materials.—New York: steel angle bars, 1.75 to to 1.8 cts.; spikes, 2.15 to 2.25 cts.; track bolts, 2.7 to 2.8 cts. Pittsburg: splice bars, 1.75 to 1.85 cts. for iron or steel; iron or steel spikes, 2.1 cts.; iron track bolts, 2.75 cts. with square and 2.85 cts. with hexagon nuts. Chicago: splice bars, 1.85 cts. for iron, 2 cts. for steel; spikes, 2.2 to 2.25 cts.; track bolts, 2.8 to 2.9 cts. with hexagon nuts.

Foundry Pig Iron.—New York: $14 to $18. Pittsburg: $14.50 to $16.50. Chicago: $14 to $16.50

Pipe.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 52½ and 42½ per cent. on black and galvanized butt-welded; 62½ and 50 per cent. on black and galvanized lap-welded. Casing 55 per cent.

Lead.—New York: 4.5 to 4.52 cts. Chicago: 4.3 cts. St. Louis: 4.2 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.9 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 1.95 to 2.25 cts.; steel plates, 1.95 to 2.15 cts. for tank, 2.25 to 2.6 cts. for shell, 2.4 to 2.6 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2 cts.; tees, 2.6 cts.; universal iron mill plates, 2.05 cts.; sheared steel bridge plates, 2.15 to 2.2 cts.; refined bars, 1.8 to 1.85 cts.; steel plates, 2.1 cts. for tank, 2.35 cts. for shell, 2.55 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.15 cts.; tees, 2.6 to 2.7 cts.; universal plates, 2.15 to 2.2 cts.; sheared plates, 2.2 to 2.25 cts. for steel; steel plates, 2.4 to 2.6 cts. for tank, 2.85 to 3 cts. for shell, 3 to 3.25 cts. for flange; 4.5 to 5.5 cts. for firebox; boiler rivets, 4.25 cts.